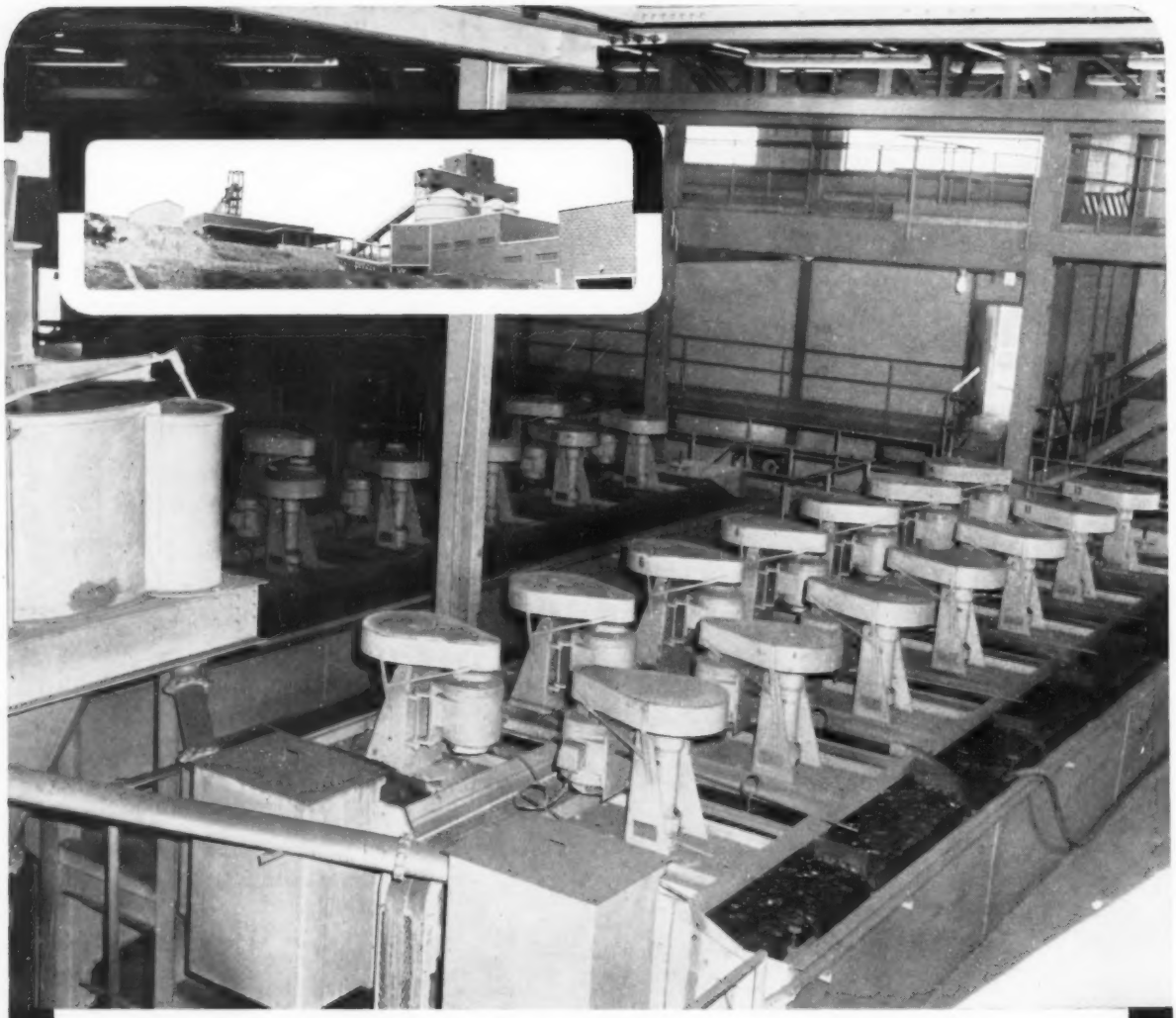
MINING WORLD

FIFTY CENTS August 1961

Beryllium Ore Flotation ▸36

Bagdad's Plastic Pond For Acid Leach ▸26

Safety at Homestake-Sapin Cuts Mine Accidents ▸22



VIBURNUM PLANT: Solid step into the future.

St. Joseph Lead Co., well known for progressiveness—and achievement—in the use of methods, equipment and technology, has made a great advance with its new Viburnum project in Southeastern Missouri.

Teamwork, imagination-and experience

Viburnum, which includes three mines, a mill, and modern community, is a product of sound planning, the combined efforts of men and their experience at work. Technical know-how, knowledge gained in a long history in the Lead Belt and other operations, plus ideas from working personnel, have produced unique methods, equipment and automated process control systems which make the new operation unparalleled for efficiency.

Wemco-Fagergrens for flotation

In the milling section, four banks of Wemco-Fagergren 66″ x 60″ 7-cell machines were selected for roughing and four 2-cell 66″ units with Pumper Cell closure for cleaning duty.

Minimum floor space required

Wemco-Fagergren machines save on valuable floor space because "Fags" are proved more productive per square foot of area. Premium savings, too, in maintenance, replacement, labor and reagents.

The story of Wemco-Fagergren is one of success for the companies it has served. A Wemco representative can tell you how this "task force" of flotation can fit most profitably in your plans for the future.

WEMCO®

a division of

Western Machinery Company

650 Fifth Street, San Francisco 7, California

and throughout the world

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This type of technical service will help you obtain—in your own plant—the lowest possible screening cost. Call Tyler for help on your separation problems. From thousands of types of Tyler woven wire cloth, we can recommend the right type for your requirements.

TYLER

Standard of the world Tyler Standard Testing Sieves are recognized world-wide as the standard for classification of granular materials. This testing equipment tells you what sizes are present in raw materials, relative proportions, and helps you meet specifications and control quality.

TYLER CUTS YOUR COST OF SCREENING

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TD-25 outproduces '24' New Power advantages high-walling—*for Morris Enterprises,*

by 20%... speed

Owensboro, Ky.

"The new International TD-25 is giving us about 20% more production than our TD-24," states Paul H. Morris, owner of Morris Enterprises, Owensboro, Kentucky. "The '25's' DT-817 turbocharged Diesel is snappy, doesn't lug down, and has the power to carry full loads without hesitation.

"I particularly like my '25's' Planet Power steering and Hi-Lo power-shifting advantages for high-wall cutting—and the good balance, which enables backing up steep grades and starting the push immediately.

"My TD-24 has clocked better than 10,000 production hours in four years, with outstanding service and very low downtime."

Full-cut benching—full time

Apply full power to the job—maintain full speed—keep the blade loaded full time—benching or high-walling with the International TD-25. You simply operate the bankside track in high speed range, the other in low speed range—for full-capacity straight ahead performance, without "fish-tailing" or "bank-nosing."

You make full-load, full-power turns with TD-25 "live-track" Planet Power steering. And with combined Hi-Lo power shifting, you get instant up-or-down matching of power to condition. You eliminate "dead-track drag" and "gear-shift" lag—and benefit accordingly.

See how the 230-hp TD-25 outproduces king-sized clutch-steered rigs by up to 50%, or more—clearing land, removing overburden, highwalling, and benching. Compare DT-817 turbocharged Diesel wallop—measure how dual-valving insures "free breathing" for clean combustion and big work capacity at all altitudes. Let your International Construction Equipment Distributor demonstrate.

"Slugging" straight ahead with an offset load of shot rock, this TD-25, belonging to Morris Enterprises, demonstrates the capacity-adding Planet Power steering principle. Operator keeps bank-side track in high range, leaves other in low range, to stay on course, with full power "harnessed." This producer removes about half of a 35' overburden with crawlers—takes off the balance with dragline.

International*® *Construction Equipment

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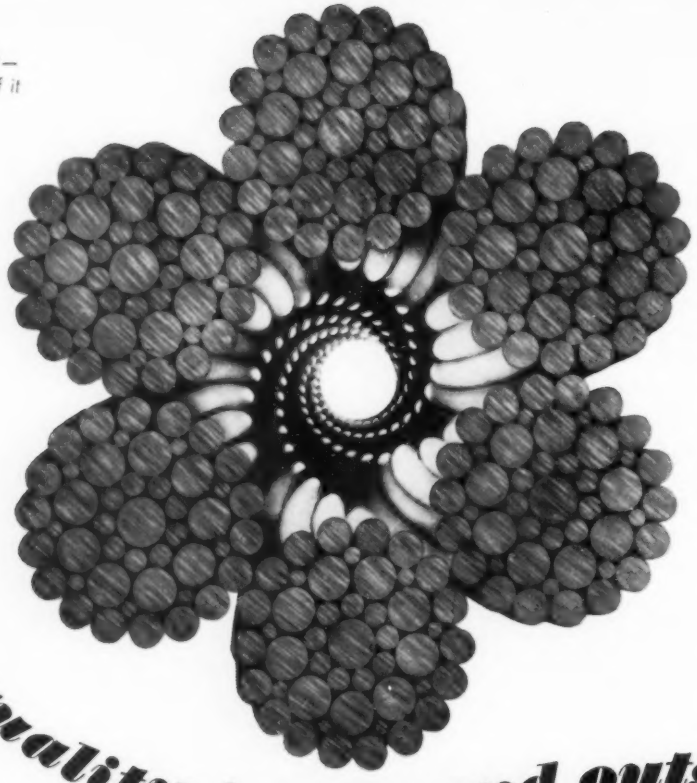
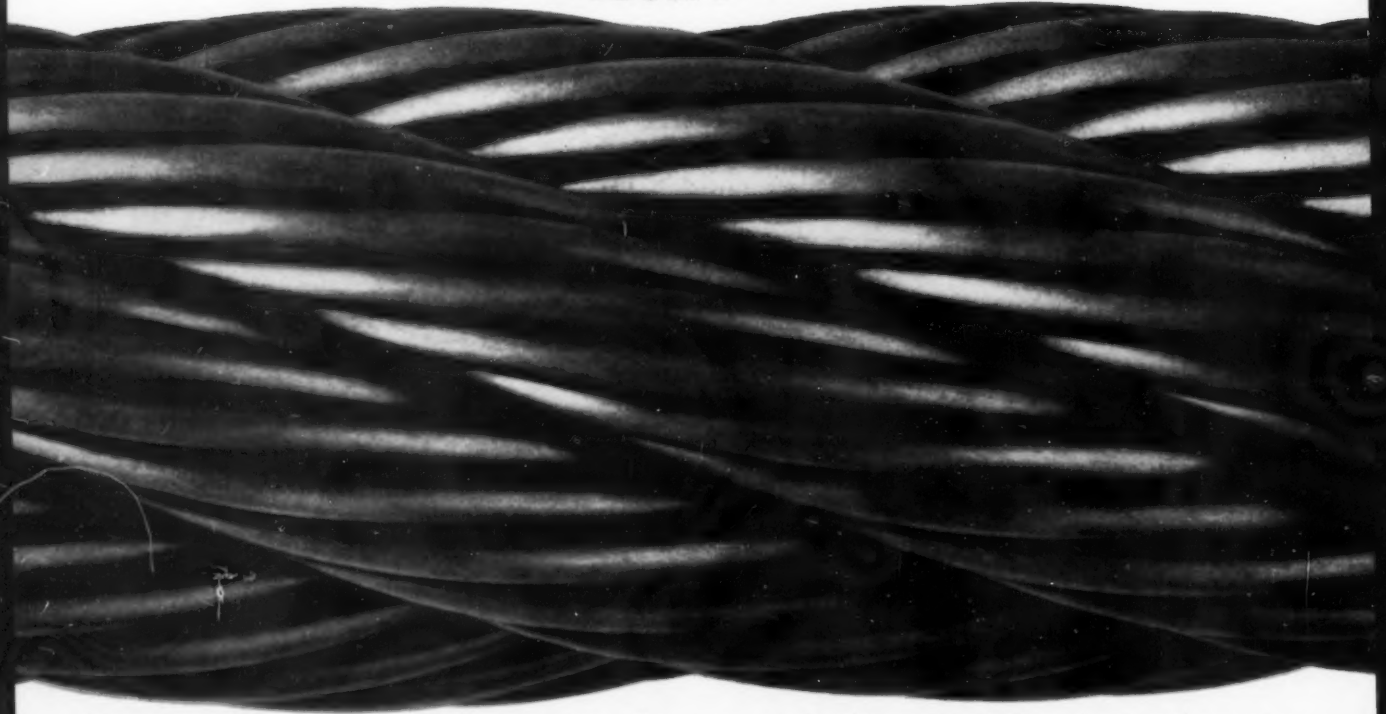
You get a lot of work out of it



Quality inside and outside



Two important angles on wire rope savings: the *quality* and *uniformity* Roebling builds all the way through Royal Blue Wire Rope. They give you a big, extra margin of service through every kind of wear and tear — and combine to make extra strong Roebling Royal Blue the toughest wire rope you can buy. Find out more from your wire rope distributor, or write for free booklet to Roebling's Wire Rope Division, Trenton 2, N. J.

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GOVERNMENT ACTION AND REACTION AFFECTING MINING

Interior Department Fails to Come Up with a Domestic Minerals Policy . . .

A good many people interested in the domestic lead-zinc business gathered in the House Interior Committee's hearing room on June 16, eager to hear what Secretary of the Interior Stewart Udall had to say about the government's opinion on the small mine lead-zinc subsidy bill H. R. 84 and a long list of similar bills. Called by Mining Subcommittee Chairman Ed Edmondson, the hearing was cancelled because of a last minute phone call from the White House the night before.

It appears that no reports on the bills were yet available as government policy on domestic lead-zinc production and protection had not been decided upon.

A similar bill, it will be recalled, was passed by the last Congress over the objection of the Interior Department and promptly vetoed by President Eisenhower. At one point in the presidential campaign President Kennedy indicated sympathy for the proponents of the bill and implied that he might have signed it. What one says before he is in office and after he is in office and subject to various departmental pressures are frequently different things. Members of the Interior Committee had hoped that the appearance of Interior Department officials at this hearing, regardless of the character of the testimony on H. R. 84, would give them an opportunity to put searching questions regarding mineral policy.

Two years have elapsed since the Aspinall resolution was passed, demanding the formulation of a minerals policy, and nothing constructive has been released. Back in 1943 President Roosevelt did issue such a policy. Although largely concerned with war-time conditions and possibly not applicable now, at least it was pointed at helping the small mining groups and it should not take too much cerebration to revamp it and reissue it on a present time basis.

This technique of delaying legislation that is unpalatable to the agencies is nothing new. Chairman Edmondson indicated that if a report is not available before long he may try to get his bill passed in spite of the departmental attitude, but it seems most unlikely that this could be done. The entire outlook for a lead-zinc bill at this session of the Congress seems to grow dimmer and dimmer.

President's Guide Given for Wilderness Areas . . . "Balanced Usage" . . .

Regarding the various attempts to pass a "wildlife" bill which would withdraw large acreages from the public domain and seal them up against everyone but campers and trampers, one should point out that President Kennedy has remarked on the point of "balanced usage" of the public domain. The director of the Bureau of Land Management, Karl S. Landstrom, interpreted this as meaning, "a balance of uses from the standpoint of the entire system."

If literally interpreted, where would this leave the wilderness area enthusiasts and the Society for the Preservation of the Whooping Crane?

Senator Church Advises Treasury to Hold Reserves of Free Silver . . .

Senator Church of Idaho, warning the Treasury Department against exhausting our free silver reserves, recently stated:

"Unless the Treasury retains its remaining reserves of free silver—seriously depleted as they already are—it will soon be forced to either:

"First: Enter the market in competition with other governments and private users, thereby being forced to pay, perhaps, upwards of $1.20 per ounce for the silver which it is now selling to favored users for 91 cents per ounce; or

"Second: Demonetize the silver which backs roughly a fifth of our paper currency, in order to obtain silver metal for coinage, replacing the silver-backed currency with debt-backed notes."

The Treasury Department has as yet made no official statement as to what its policy is to be.

Bureau of Mines Research Does Not Lead to Economic Progress . . .

Research is a wonderful thing, and in the long run necessary and productive. The new studies of the Bureau of Mines, "mainly concerned with finding new methods of taking rocks apart, with the search for basic knowledge regarding the forces that hold rocks together, utilizing man's knowledge of explosives, mechanical engineering, electricity, chemistry, and thermodynamics," to quote Assistant Secretary of the Interior John M. Kelly, will be a major step on the road to human progress. In the meantime, lacking a domestic minerals policy which will be a major step on the road to economic progress, when do we eat?

Public Land Disposals Would Gain Momentum Under Proposed Bill . . .

The move to dispose of public lands to states, local governments, and individuals is gaining momentum. The Interior Department is pushing a bill to permit the acquisition of tracts up to 5,000 acres to qualified state and local government agencies for urban and business development, and by competitive bids 1,280 acres to individuals and companies for the same purposes. If and when this bill becomes law it should initiate a new type of speculation and land rush.

NEW DUPONT SUPER "TOVEX" GEL GIVES YOU 20% MORE POUNDS PER FOOT...MORE PUNCH PER POUND

You *handle* it like regular "Tovex" Gel.

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But when you *shoot* it, you know it's *Super* "Tovex" Gel – the new non-nitroglycerin gelatin that is now available in a 20% denser grade to help you break hard rock at lower cost.

Not only is Super "Tovex" non-nitroglycerin gelatin 20% heavier per foot of borehole, but it also packs a higher explosive wallop per pound. You can – in many cases – increase your burdens and spacings. So, you save drilling costs.

What else?

Besides higher bore-hole density and more usable energy, here are other ways you can improve your blasting with Super "Tovex" Gel:

More Safety: You operate more safely than with nitroglycerin dynamites.

No Headaches: No ingredient to cause headaches among your blasting crews.

Won't Propagate: Lets you take advantage of short interval delay blasting, even in the most saturated ground... without propagation between holes.

Resists Water: You can expose it to high heads of water for long periods of time.

Loads Easily: Just slit the bag and drop into the hole to get maximum density. A small loading crew can do the job.

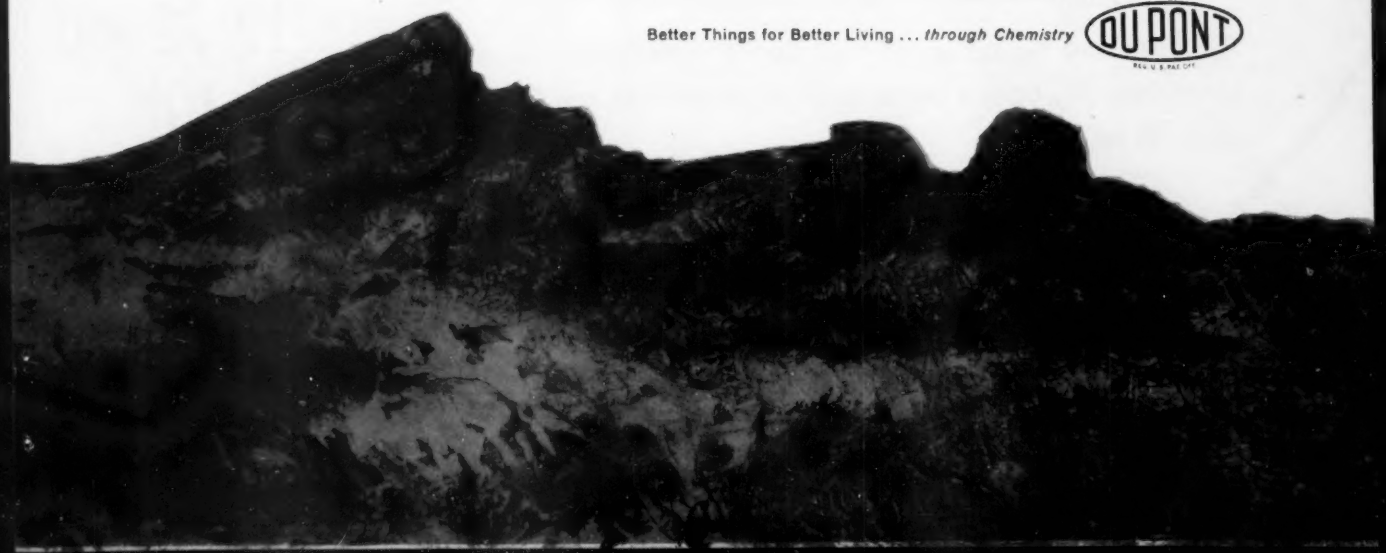
Primes Easily: Can be primed with Du Pont HDP-1 Primers, "Nitramon" Primers, "Nitramite" Primers or "Hi-Velocity" gelatin dynamite.

How soon do you want these savings?

Super "Tovex" Gel is ready now. Your Du Pont Explosives representative or distributor has it. Call him for further information, or write: Du Pont, 2446 Nemours Bldg., Wilmington 98, Delaware.

Super "TOVEX" gel

Better Things for Better Living ... *through Chemistry* DU PONT



There's a "Euc" Rear-Dump just right for your work!

Whatever your mine and quarry hauling job may be — stripping overburden, waste disposal, moving ore, rock and other materials— there's a type and size of job proved Euclid that can cut costs and step up production. With unmatched field experience and the parts and service facilities of a world wide dealer organization, "Eucs" meet every requirement for big performance on the toughest jobs.

For facts and figures proof that Euclid work-ability can mean lower costs and bring a better return on investment, call the Euclid dealer in your area.

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R-22 22 TONS
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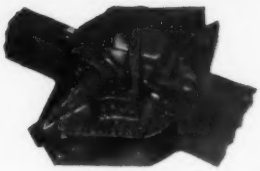
PLUS

12, 22 and 35-TON Semi-Trailer Rear-Dumps

GM GENERAL MOTORS EUCLID

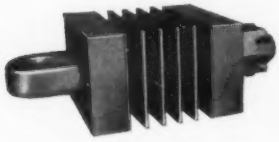
EUCLID

DIVISION OF GENERAL MOTORS, HUDSON, OHIO
Plants at Cleveland and Hudson, Ohio and Lanarkshire, Scotland



Irwin specifies

WILLISON AUTOMATIC COUPLERS



NATIONAL CUSHIONING DEVICES

NACO CAST STEEL WHEELS

for new welded aluminum mine cars

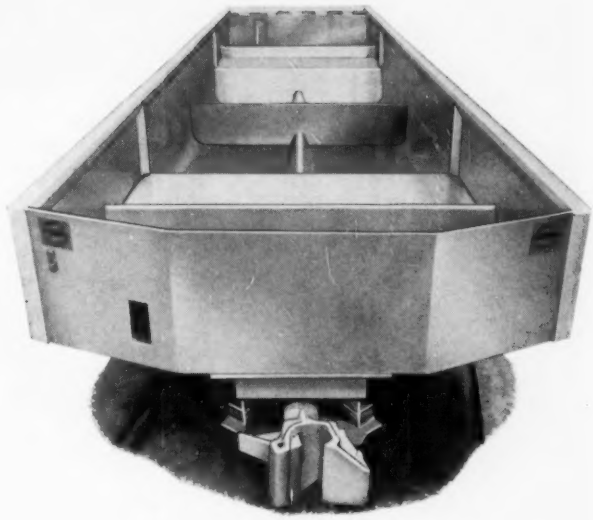


Photo: Courtesy Irwin-Sensenich Corporation, Irwin, Pa.

The new welded-aluminum 8-wheel cars being built by Irwin for one of the country's largest coal mines are the last word in modern rotary dump car design for faster, safer, more efficient haulage. And to keep them operating faster . . . safer . . . *years longer*, they are equipped with National mine car specialties:

Willison Couplers — Extremely wide gathering range . . . couple automatically . . . no need to go between cars to uncouple.

National Cushioning Devices — MI-230-5 longitudinal rubber cushioning devices absorb end-to-end impacts for extended equipment life at higher speeds.

Naco Cast Steel Wheels — High yield point electric furnace steel gives exceptional tensile strength and ductility to whip premature tread spalling and flange breakage.

King Pin Castings — Special high tensile steel ball bearing king pin castings give utmost strength . . . resist abrasion even under roughest service.

For new cars — or for equipment upgrading programs — *look into National mine car specialties for maximum speed, safety, tonnage, life.*

Mine Sales • Transportation Products Division

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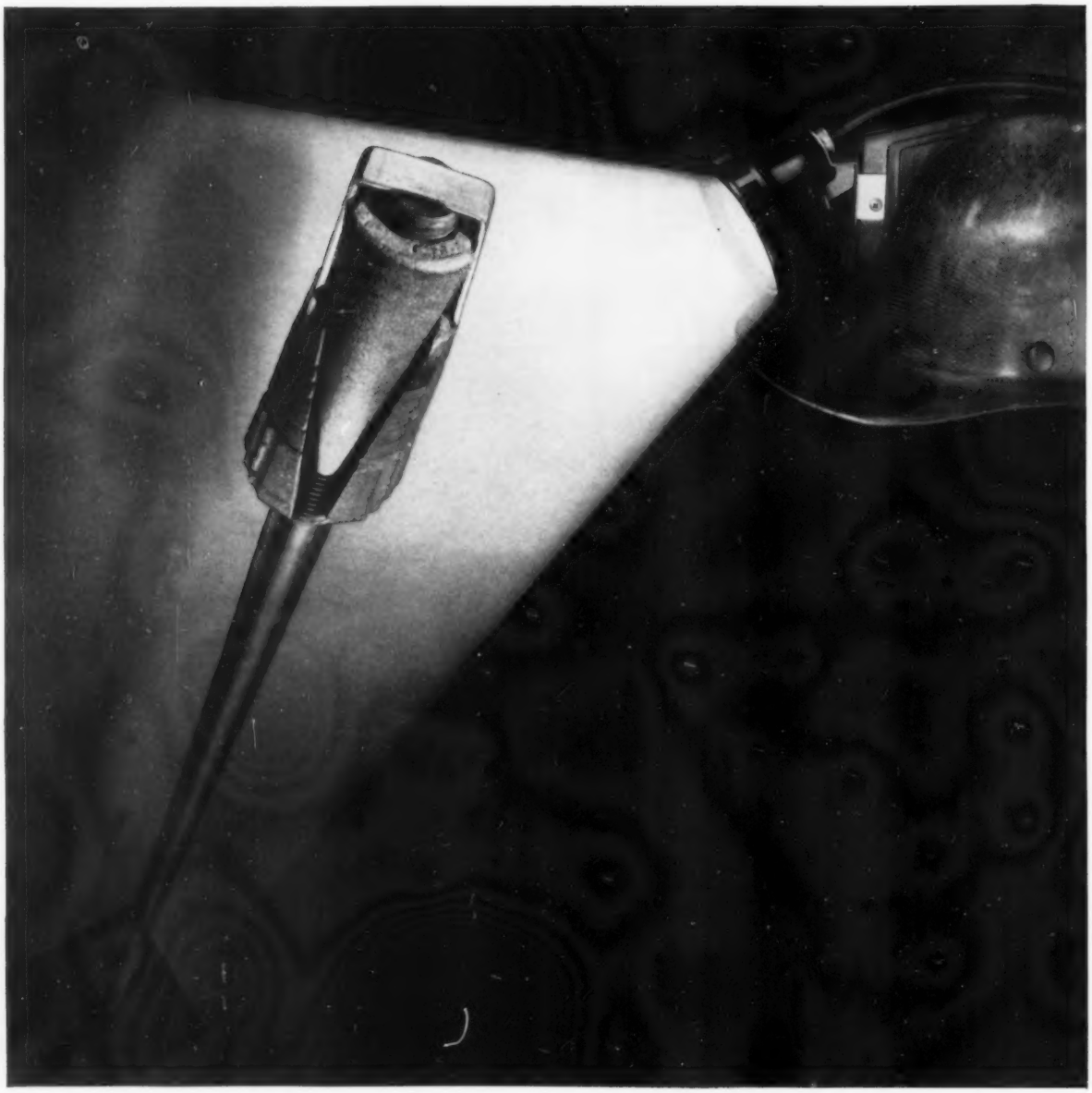

Looking for a way to save money safely?

Then look at CF&I Rock Bolts with the Pattin Shell — the truly modern form of roof, wall and back support to reduce both costs and accidents.

Mine records have shown that CF&I Rock Bolts with lagging of Realock Metallic Fabric mean savings of up to 35% over conventional timbering.

And CF&I Rock Bolts provide greater safety because the double expansion shell makes continuous contact along the entire length of the shell. This means that in any type of rock you get maximum anchorage and resistance to load with minimum displacement of the shell.

Put these two factors together and you've got a combination that's hard to beat. Your nearby CF&I sales office will be glad to give you complete details on Rock Bolts—either Expansion Type with Pattin Shell or Slot and Wedge Type—and other CF&I Mining Products. Call today.

8308

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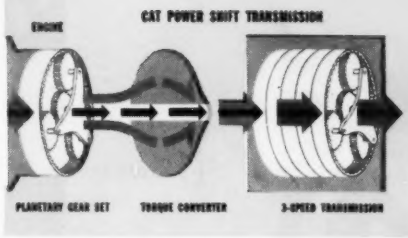
For a variety of durable industrial products

See you at the American Mining Congress Convention, Seattle, Washington, September 10-13.



The exclusive Cat power shift transmission works like this: The engine drives planetary gears in the flywheel, where output torque is divided. Part of it is routed to the transmission through a torque converter (providing anti-stall and load-matching ability). Part goes direct to the three-speed transmission (provides economy and fast response of direct drive). It's one ton of muscle built with the precision of a fine watch.

WITH CAT POWER SHIFT TRANSMISSION IN A D8H, A MAN'S FINGER TIPS CAN CONTROL 30-50% MORE PRODUCTION

Your present equipment may move material at low cost—but here's one reason a D8 Series H Tractor may move it a lot cheaper.

It's the Caterpillar power shift transmission—the only transmission available that combines the advantages of direct drive, torque converter drive and power shifting in a single unit. It greatly increases operator efficiency—offers important new opportunities for broadening your profit margin.

Here's how this big step ahead in transmission design helps your operator get more work from the machine: A single selector lever replaces the familiar master clutch, gear change and forward-reverse levers. Using this single selector lever, the operator can shift on the go in a split-second even under full load. He changes speed or reverses direction with finger-tip ease . . . without clutching . . . without braking . . . without even lifting his arm from the arm rest. And the lever is mounted for left-hand control, leaving the right hand free for maneuvering the tractor or controlling the dozer, ripper or scraper. Convenience makes it easy to choose the right speed at the right moment.

Matching this ease of control are safety features you'll like. A safety lock in the selector housing holds a parked machine in neutral while the engine is running. Another safety device automatically shifts the selector lever to neutral when the engine is stopped.

The simplicity and safety of the Cat power shift transmission make your good operators even better and less experienced operators more effective. They can take greater advantage of the tractor's power and capacity to speed the work. And ease of operation keeps their efficiency high throughout the day.

Cat power shift transmission also means a big jump in your machine's efficiency too. You'll particularly notice the difference on jobs where frequent shifting is the rule—such applications as feeding a shovel or short-cycle dozing.

For instance, in dozing, the operator starts to pick up the load in second gear—then shifts on the go to first for full lug yardage. There's no clutching, no lost time or momentum when changing speeds. An easy move back to second drifts the material to its destination. Another move of the lever puts the machine in high-speed reverse for fast return to the digging area.

Machine efficiency is *always* high. Cat power shift transmission provides the needed power at the highest possible speed. Its exclusive torque divider design combines the snap and economy of direct drive with the load-matching ability and anti-stall characteristics of torque converter drive—and three forward-reverse speeds tailor it to the entire working range.

Just how much of an increase will the Cat power shift transmission make on your job? This will depend on your application. On short-cycle dozing, reports in our file show increases *as high as 50%* over similar-sized machines with other transmissions. Some users flatly state they will never buy another track-type machine in the 200 HP class unless it is a Cat power shift unit.

Power shift transmission is just one reason the D8H may be a far better profit tool than the machine you are now using. There are other features of this 235 HP turbocharged tractor that could be equally advantageous in your work. Your Caterpillar Dealer will welcome the opportunity to discuss the D8H in terms of your job and present facts and figures so you can determine true benefits. And if a demonstration with measured results would help, he will be glad to make arrangements.

Call him today.

Caterpillar Tractor Co., General Offices, Peoria, Illinois, U.S.A.

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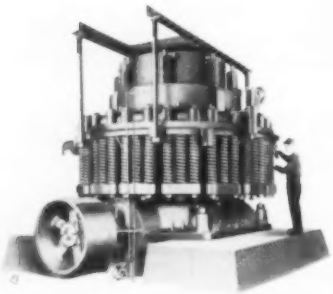
STEP UP PRODUCTION AND PROFITS WITH POWER SHIFT TRANSMISSION

Dolomite

the "building blocks" of progress

When Nature adds magnesium to limestone, the result is *dolomite*. In the form of crushed aggregate, it is used for road building, in concrete dams and other engineered construction projects. As crystalline dolomite marble, it is used as ornamental building stone. And because of its magnesia content, it is widely used in making refractories for open-hearth furnaces and Bessemer converters. Found in massive beds throughout the world, dolomitic limestones are truly the building blocks of progress.

In processing this rock-mineral, Symons Cone Crushers have again maintained their leadership in high capacity, low-cost production of finely crushed product. *For in dolomite as in all important rock and ore crushing operations around the world,* Symons Cone Crushers are first choice of leading producers.



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. . . The machines that revolutionized crushing practice . . . **are built in a wide range of sizes, for capacities to over 1500 tons per hour. Write for descriptive literature.**

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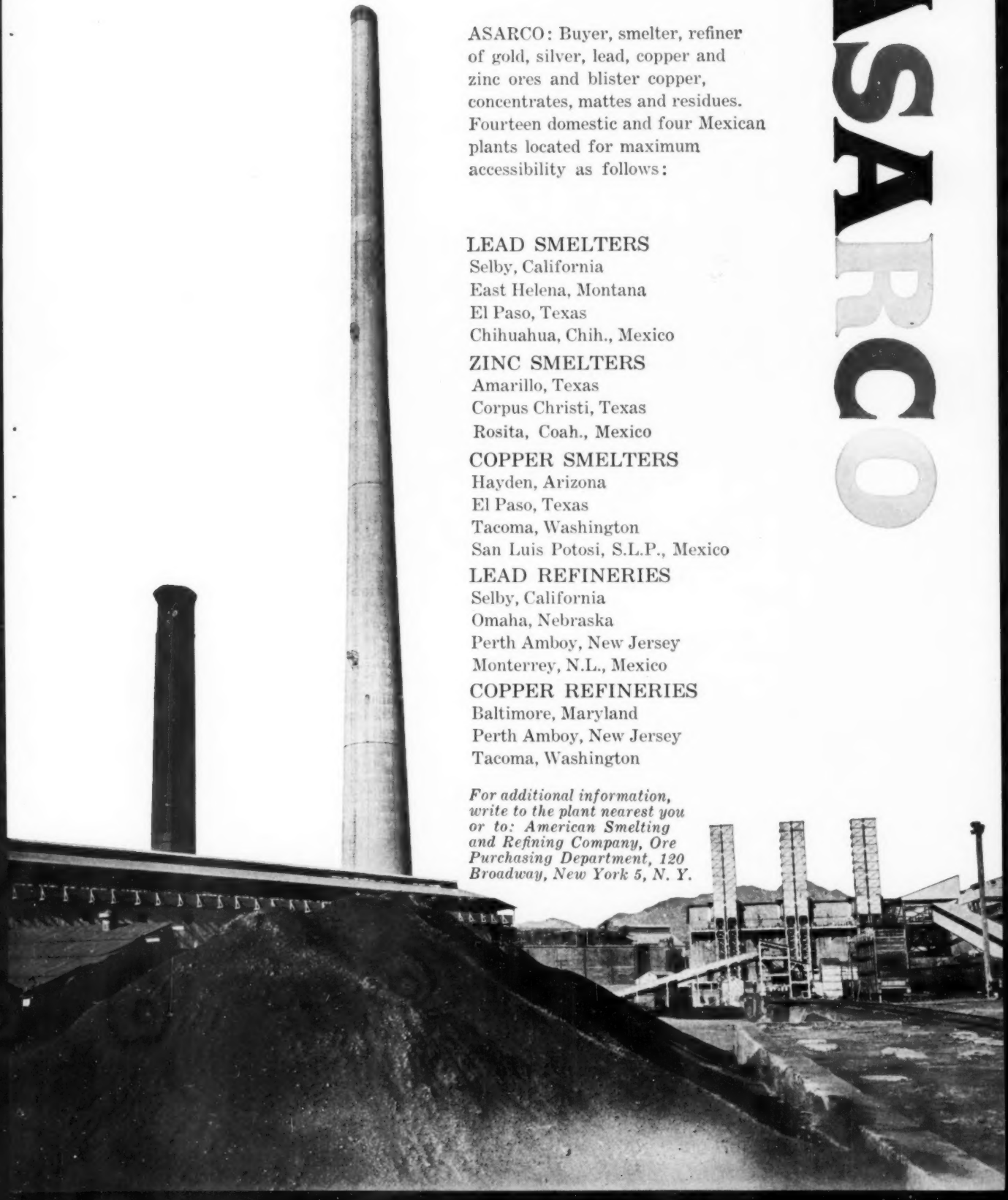
For additional information, write to the plant nearest you or to: American Smelting and Refining Company, Ore Purchasing Department, 120 Broadway, New York 5, N. Y.



Two cost-whacking Payhauler® units equal five 11 cu. yd. haulers

—for Quality Lime Products Corp., Sumterville, Florida

Up the soupy, slippery ramp, the 95 Payhauler steadily climbs out with its 27-ton loads of lime rock. Dragline excavated from underwater, the dripping wet rock keeps the ramp sloppy, while being hauled up to the stockpile.

Quality Lime Products Corp., Sumterville, Florida, has proved that two 95 Payhauler units match production of *five* 11-cu. yd. end-dumps. The savings in labor and operating cost are huge!

Only two rigs to man, fuel, and maintain instead of five. Only minimum dead weight to move. Payhauler has the International-developed weight-shedding corrugated body, that increases ton-toting capacity and climb-ability.

"On this wet ramp operation, the DT-817 engine, through torque converter transmission, assures maximum tonnage without loss of traction," states Superintendent W. W. Reynolds. "The Payhauler is well-balanced, easy to operate, and operator acceptance has been excellent. Each '95' stockpiles up to 1,500 tons of material per 10 hrs., hauling 1.3 miles."

Power-punch of the 27-ton 95 Payhauler is the International DT-817 diesel—turbocharged to deliver 375 high-torque hp, through power-shift torque converter or 9-speed air-shift transmission. The 19-ton 65 Payhauler is also powered by the "817," naturally aspirated to produce 250 hp through 10-speed constant-mesh transmission.

And both Payhauler models have full-torque-taking planetary final drive design—reserve area power braking—"one-hand," road-holding power steering—11-second dumping.

Compare Payhauler grade charts—compare cycle-gaining Payhauler performance on grades and tough hauls. Size-up Payhauler dependability and long life features. Let your International Construction Equipment Distributor demonstrate.

In typical slippery, sloppy going, a 95 Payhauler climbs with its full load of wet lime rock—for Quality Lime Products Corp., Sumterville, Fla. The ramp rises 40 feet, and has two turns, in the first 500 feet of the haul!

With exclusive action-speeding, inverted hoist design, a 95 Payhauler dumps its load in only 11 seconds, ready to high-tail back for another load. The lime rock is air dried, then fed to crusher by dozer and dragline to produce road base and stabilizing material.

International®* *Construction* *Equipment

International Harvester Co.,
180 North Michigan Ave., Chicago 1, Illinois
A COMPLETE POWER PACKAGE

NEW Crawlmaster drill and Gyro-Flo compressor

...most versatile and powerful combination available for 4" to 6½" blast holes

THE INGERSOLL-RAND CRAWLMASTER is a multi-purpose blast-hole rig with extra weight and power for the toughest drilling jobs. This rugged machine is mounted on dozer-type crawlers with enclosed gear drive from two 11½-hp air motors, and interchangeable drill units permit percussion, rotary or Downhole drilling of 4" to 6½" holes at any angle from vertical to horizontal. Features include hydraulic feed and retraction, remote controlled reverse rotation, 30" hydraulic leveling jacks and simple ejector-type dust collector.

Ample air power for all Drillmaster functions is provided by a 900-cfm Gyro-Flo rotary compressor—the last word in portable compressor economy and dependability. Simplicity of operation, freedom from maintenance, small size and light weight, air temperatures under 200°F, low oil consumption and closer regulation at all loads make Gyro-Flo the ideal running mate for the new Crawlmaster drill.

Ask your I-R distributor or engineer for complete information on the cost-saving Crawlmaster Gyro-Flo combination.

Ingersoll-Rand

67A14 11 Broadway, New York 4, N. Y.

A CONSTANT STANDARD OF QUALITY IN EVERYTHING YOU NEED FOR DRILLING ROCK

Sala Safety Block Stops a Fall Where It Starts

SOME TYPICAL USES

Mining:
Open Pit Scaling, Ore Passes, Grizzlies, Ore Bins, Material Handling in Cages, etc.

Broadcasting: Rigging of aerials.

Hydro: Power lines, Dams.

Aviation: Working on aircraft wings.

Oil & Gas: Rigging of towers, Plant Maintenance.

SALA Safety Block SB-57 has been developed through the co-operation of the Swedish industry and Sala Machine Works in Sweden. It replaces conventional life-lines that frequently required an assistant to keep the line taut during movements of the worker.

The Sala Safety Block SB-57 contains a life-line of Steel Wire Rope, 16 feet long. With normal movement, the rope pulls out and winds up automatically on a spring loaded drum. (Can be locked if desired.) A sudden pull, as caused by a fall, will immediately engage the rope and limit its run to approximately one foot, through a friction brake on the drum. This means that a fall is stopped where it starts, eliminating the risk of injuries caused by a slack life-line.

1961 BLUE RIBBON MINING AWARD

To

SALA MASKINFABRIKS AB
SB 57 SAFETY BLOCK

for achievement in equipment development aiding the technological advancement of the mining industry.

AWARDED BY
MINING WORLD/WORLD MINING

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SALA MASKINFABRIKS AB

SALA - SWEDEN

Versatile Cat Wheel Loader scores high in tough grind at 3-shift tungsten mine

Cat Wheel Loader makes fast work of truck loading at Tungsten Mining Corp. operation, Henderson, N.C. The cut and fill method is used to mine the tungsten-bearing quartz rock. Ore is brought to the surface, loaded into trucks and transported to the processing mill. The waste material is then returned to the mine for use as fill.

TUNGSTEN MINING CORPORATION keeps its Cat 944 Wheel Loader rolling 24 hours a day, six days a week. On first shift at the mill the 2 yd. 944 truckloads ore tailings which are hauled back to the mine and dumped down or near the shaft. On second and third shift the loader runs back to the mine and dozes the stockpiled tailings into the shaft, backfilling the mined area.

"There are several big reasons why we've got a 944 doing this work," Vice President and General Manager W. L. Kendrick told us. "Look at it step by step: first of all we need dependability when we're running a machine 24 hours a day, and our experience with Cat has been just that—dependability. In the truck-loading operation, I don't think there's a faster-cycling loader than the 944. Its excellent visibility, power shift transmission and automatic bucket positioners really simplify the operator's job. At the mine we've got the loader working as a bulldozer in that tough abrasive quartz. The 944 doesn't spin its tires much; it's got the proper power-to-weight ratio to push that stuff without spinning. And when an operator is running the loader from the plant out to the mine, the tight steering gives him confidence to roll fast, not waste time snailing along the highway."

For speed, durability and utility in any mining operation, you can't beat Cat Wheel Loaders. There are three diesel-powered units to choose from with bucket capacities up to 4 yd. (Gasoline power is optional on the two smaller models.) Ask your Caterpillar Dealer for specific mine application data. He'll show you how to cut your handling costs.

Caterpillar Tractor Co., General Offices, Peoria, Ill., U.S.A.

CATERPILLAR

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CAT LOADERS FOR SPEED, FOR LOWER COSTS

Two Trends In Mineral Discovery

• Standards for mining claims as set by Interior Department don't follow those set by Congress and the Supreme Court

"It is my conclusion that there are two trends in the mining claim discovery requirement," reported mining attorney, Raymond B. Holbrook, of Salt Lake City, Utah, at the Idaho Mining Association's Sun Valley, Idaho meeting.

Mr. Holbrook said, first, that recent court decisions (particularly for uranium) evidence a relaxing of the mineral showing required as proof of discovery. Secondly, that recent decisions of the Interior Department evidence a trend toward a concept that a producing mine is a condition precedent to a valid mining location. How significant is the statement "No showing that the ore is marketable is required," when the Department insists that there must be "a showing of the probable existence of a mineral deposit that can be developed as a paying mine. . . ." Is this not tantamount to saying a mining claimant does not have a valid location until he has *proven* that his reasonable prospect of success—his reasonable expectation—has become a reality? I am informed that it is customary in the industry to have reasonable assurance of a profitable operation before a mining property is developed? If that be so, is not a requirement that there must be a showing which warrants development, in effect requiring a showing of marketable ore?

There now are two categories of discovery based on the types of minerals—Common Place minerals and Limited Occurrence minerals, he said. For the first type a secretary of the Interior decision on sand and gravel has now set a "marketability rule" for contesting patents on pumice, gypsum, limestone, clay, and building stone. Thus the ruling is that establishment of a valid discovery (sand and gravel) requires clear and convincing evidence that the minerals are of the quality acceptable for the type of work (use) being done in the market area, that the extent of the deposit is such that it would be profitable to extract it and process it—if that is necessary—and that there is a present demand for it.

For many years the classic rule of discovery for Limited Occurrence minerals such as gold, silver, lead, and uranium has been the "prudent man" discovery where a person would be justified in the further expenditure of time and labor for exploration with a reasonable prospect of success in developing a valuable mine.

Recently, however, rulings show a reversal to stress the importance of "development" rather than "exploration." The Bureau of Land Management has followed this concept also.

Mr. Holbrook summarized the discovery determination decisions as follows:

1. With respect to minerals of wide occurrence, such as sand and gravel and other commonplace minerals, it is necessary to show that the deposit can be "extracted, removed, and marketed at a profit."

2. With respect to minerals of limited occurrence, such as gold, silver, copper, lead, zinc, and uranium, it is necessary to show "the probable existence of a mineral deposit that can be *developed* as a paying mine with a reasonable prospect of success." The test of discovery is not satisfied by a showing of mineralization in place which would induce a prudent person to undertake further exploration.

Thus, administrative application of the rule of discovery is destroying the mining laws by erosion and indirection. He called for a united industry stand against such procedures.

AEC Sets Domestic Uranium Purchases

For the next 12 months, or fiscal year 1962, the AEC will buy a total of 17,905 tons of concentrate with a value of $294,400,000. The same level of annual purchases is expected through 1966.

New Mexico with its important Jackpile and Paquate open pits and underground Ambrosia Lake mines will supply the most concentrate—7,875 tons valued at $124,000,000. Utah from its Big Indian district will supply 3,050 tons at $52,300,000. From Colorado's Uravan Mineral Belt will come 2,850 at $47,800,000. Wyoming's famous Gas Hills plus Shirley Basin will produce 2,895 with a $47,100,000 value. Other states are: Arizona, 275 and $5,500,000; Washington, 280 and $5,100,000; the Dakotas, 510 and $9,400,000, and Texas, 170 and $3,200,000.

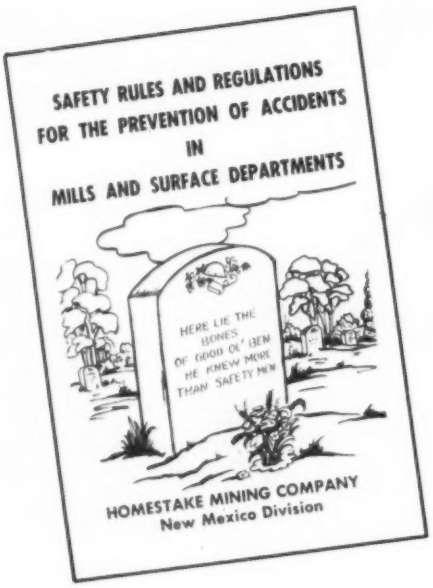
Kennecott Expands Copper Plants in Chile

Braden Copper Company is expanding its Chilean copper production facilities to a 191,200 ton annual rate. This will actually be about a 5.0 increase in production over the nominal capacity of 182,000 tons. However, in 1960 production actually was 187,221 tons of copper from a record 11,518,005 tons of ore mined and milled. Output in recent years has been limited by strikes and the shortage of hydroelectric power during the winter months.

The expansion, to cost $6,000,000, is to be completed by December 31, 1961 under the terms of the company's agreement with the Chilean government. This is a separate and distinct program from the planned deep level tunnel, new mill, power plant etc. which would cost $200,000,000 and raise production capacity to 280,000 annual tons.

Expansion will essentially consist of a new secondary crusher, one new 10 by 10 foot ball mill, 24 new flotation machines, and modifications to existing smelting and refining facilities. Kaiser Engineers International of Oakland, California has contracted for engineering, construction management, and procurement for the expansion. Much of the new equipment is now on order.

The Braden mine, the world's third largest, in 1960 in point of tonnage mined underground, also ranks third in total tonnage mined at any mine and is first in total underground tonnage. The 300,000,000th ton of ore was mined in early May. Ore by copper standards is high grade and averaged 1.995 percent copper in 1960.



How Homestake Sapin's Safety Program Cut Ambrosia Lake Accidents

by **H. J. Abbis**

Mr. Abbis is safety director for Homestake-Sapin partners and is also president of the Uranium Operators Safety Council. He graduated from the School of Metalliferous Mining at Camborne, Cornwall, England.

Managerial support, regular safety meetings and inspections, cooperation of supervisors and employees, safety and first aid courses, and a good incentive program are some of the contributing factors to the safety records obtained by Homestake-Sapin Partners which operates three underground mines and a uranium processing mill in the Ambrosia Lake district near Grants, New Mexico.

Homestake-Sapin Partners management's philosophy of what constitutes a good safety program is based on three basic principles:

1. Top management must earnestly desire to eliminate accidents and must demonstrate this to the rest of the organization by participation in the safety program, as well as insisting on production and safety being considered together at all times. Furthermore, top management must be willing to spend money and/or suffer production slowdowns when necessary, to achieve safe conditions.

2. The job of achieving safe conditions is that of all members of the management team—superintendents, foremen, and shift bosses who must clearly realize that they are responsible for the safety of their employees as well as for production.

3. The position of Safety Director must be given sufficient recognition and support by top management and the individual filling this position must have the professional ability and personality to get the respect and cooperation of other members of the management team.

Although the company has been in operation since 1957, it was not until late 1958 that the existing program listed in the box was started.

Safety Is a 13 Part Program at Homestake Sapin Partners

1. The general safety committee.
2. Departmental safety meetings.
3. Employees' safety meetings.
4. Safety inspections.
5. Safety rule books.
6. Indoctrination of new employees.
7. Radiation protection.
8. Eye protection and protective equipment.
9. Accident prevention courses.
10. First aid and mine rescue training.
11. Fire protection.
12. Incentive plan.
13. Full time safety director.

Here is how the 13-part safety program is operated by the company.

THE GENERAL SAFETY COMMITTEE—This committee was established in August, 1958 and meetings have been held once a month since that date. Members consist of the general manager, mine superintendent, mill manager, maintenance superintendent, electrical engineer, and safety director.

Duties of this committee include:

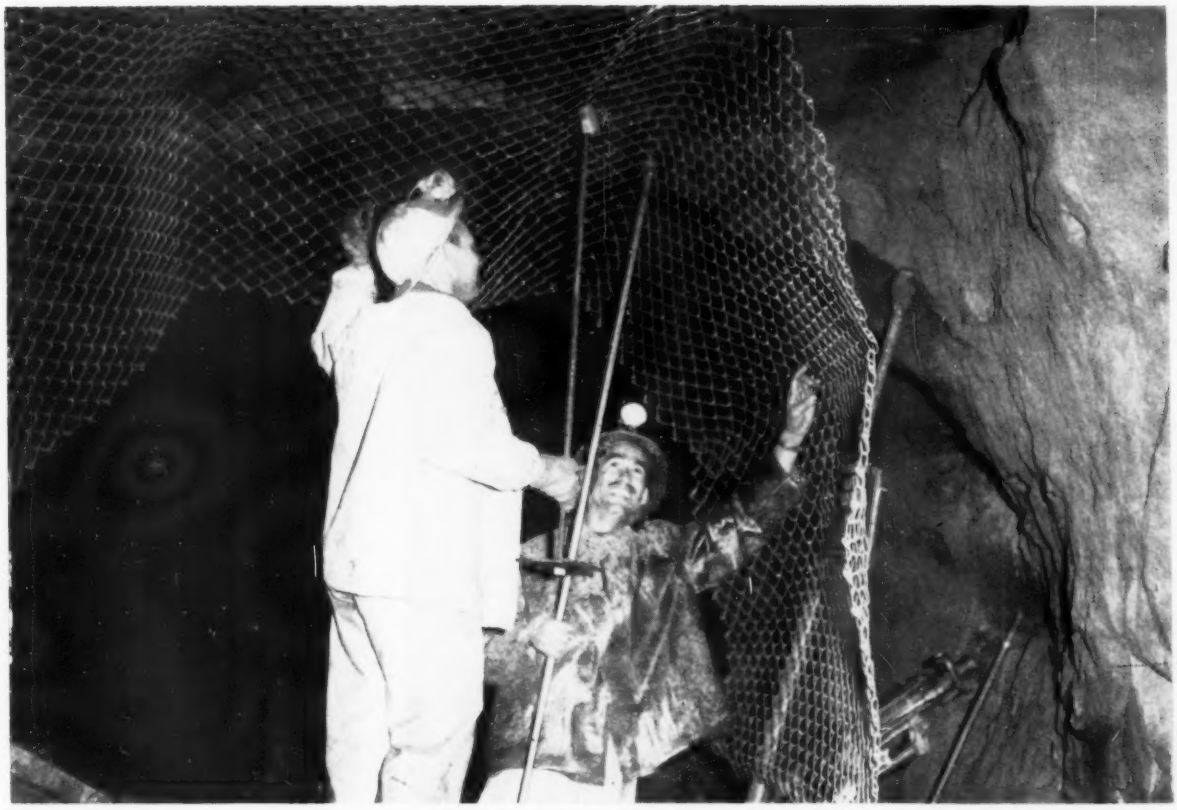
(a) Discussing accidents which have occurred and methods to prevent their recurrence.

(b) Studying reports of unusual accidents in other companies and investigating means to prevent similar accidents in the Homestake-Sapin Partners' operations.

(c) Discussing problems that arise out of departmental meetings and, if possible, making rulings or decisions.

(d) Reviewing past decisions of the committee from time to time to see whether they have been carried out, and reviewing the results of those decisions.

Regular minutes of the meetings are kept. Accidents which are discussed at the meetings of this and other committees include No Lost Time Accidents as well as Lost Time Accidents. The management believes that the causes of No Lost Time Accidents can also lead to Lost Time



CHAIN LINK FENCE is widely used as a ground support. It is anchored and held in place by roof bolts. The bolts pull the wire mesh fence tightly against the uneven rock to prevent slabbing and scaling. Miners usually do their own bolting before they drill out the round. Miner at left is inserting roof bolt to hold fencing.

Accidents and should therefore be investigated.

DEPARTMENTAL MEETINGS —MILL. The mill held its first departmental meeting in October, 1958 and meeting have been held once a month since that date. Members consist of the mill manager, general mill foreman, mill foreman, crusher foreman, mill electrical foreman, maintenance foreman, mill mechanical foreman, mill service foreman, chief chemist, chief metallurgist, and the safety director. Although not a member of the committee, the general manager frequently attends these meetings.

At these meetings any accidents that have occurred in the mill department during the month are discussed in detail and recommendations made to prevent their recurrence. Safety suggestions from employees are discussed, as well as any old or new business.

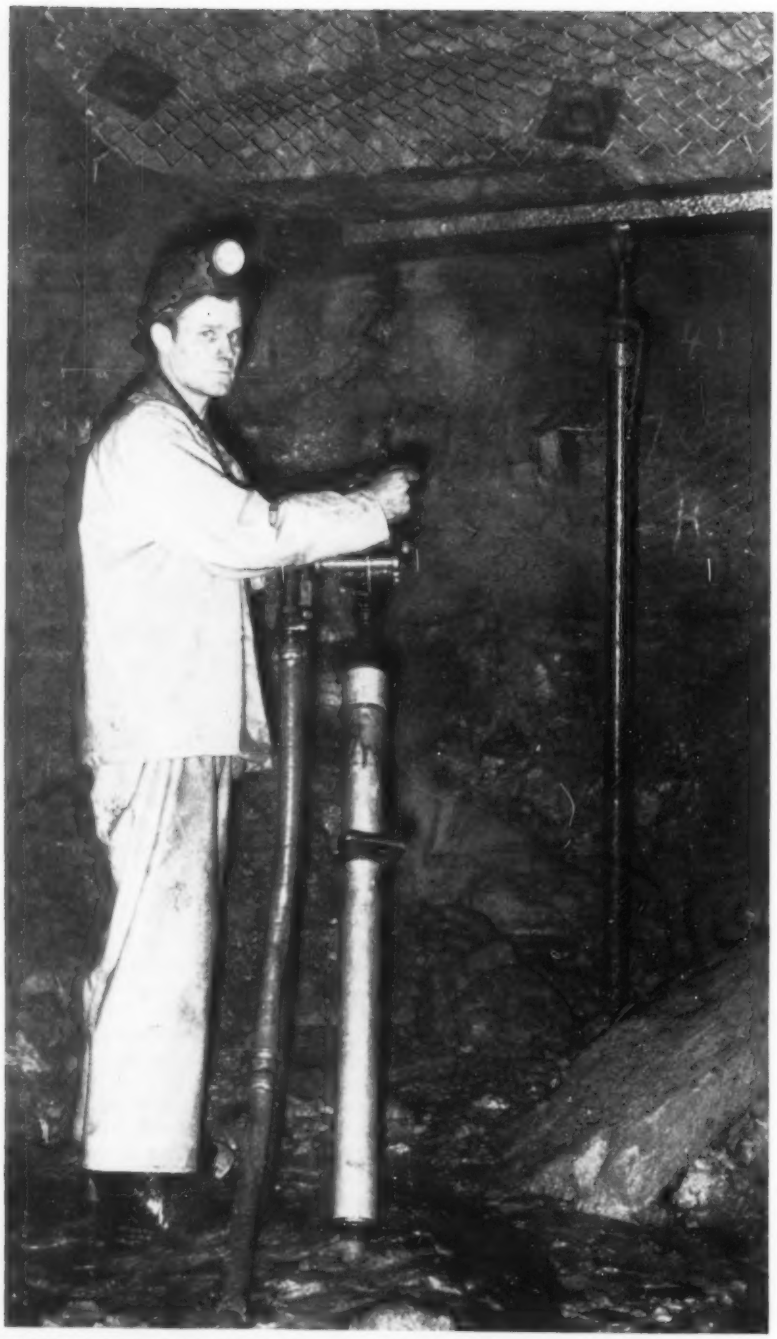
DEPARTMENTAL MEETINGS —MINE. This committee was established in October, 1958 with regular monthly meetings held since its inauguration. Members forming this committee are the mine superintendent, general mine foreman, section mine foremen, shift bosses, mine mechanical foreman, mine electrical foreman, employees' representatives from the mines and surface department, and the safety director. While not a member of the committee, the general manager frequently attends these meetings. The procedure followed at these meetings is similar to the mill meeting except that suggestions from the men's representatives as well as those from supervisors and other employees are discussed.

EMPLOYEE'S SAFETY MEETINGS—Employees of each of the mill crews attend regular monthly crew safety meetings which are presided over by the crew shift boss and attended by the safety director. Films, safety graphs, and other safety media are also introduced to encourage participation by the employees. These meetings consist of safety talks by the crew shift boss, safety director, or other persons. There is also a discussion of any accidents that have occurred and/or any unsafe conditions brought to the group's attention. The general manager on occasion attends these meetings.

In January, 1960, a new system was introduced in the mines whereby instead of regular safety meetings with the full shifts, each shift boss speaks daily on safety to as many underground employees as he can at their regular working places. Closer liaison between shift boss and men, and better participation by employees has been experienced with this method. All talks by the shifters are recorded on a card and inspected regularly by the shift foreman and safety director.

SAFETY INSPECTIONS — MILL. The safety director makes frequent inspections of the mill and either submits a report or discusses the inspection with the mill manager. Inspection teams consisting of one foreman and two employees accompanied by the safety director inspect the mill regularly and submit a report.

SAFETY INSPECTIONS — MINE. The mine foremen, accompanied by the safety director, make frequent inspections of the mines they supervise. Reports of the in-



SAFETY AT THE DRILLING FACE shows the miner standing under a wire fabric bolted back. Safety jack and long headboard support the back ahead of wire.

spections are submitted to the mine superintendent for action. Inspection teams consisting of one mine foreman and two underground employees inspect a mine other than their own once a month and submit a report to the mine superintendent and safety director. This procedure has proven to be very effective. A spirit of competition between mines is created. These inspections also help to create greater uniformity of enforcement of safety and operating standards in the different mines.

SAFETY RULES. Safety rule books are issued to all employees working in the mill and mines when they are hired. Amendments to rules are issued when this is considered necessary.

INDOCTRINATION OF NEW EMPLOYEES. A new employee who has successfully passed his pre-employment medical examination is indoctrinated before being referred to his foreman for regular work.

Indoctrination of a new mine employee necessitates that the employee, during his first shift, accompany a mine foreman on his rounds so that he can be shown all the items listed on a job instruction sheet. At the completion of the safety tour, both the new employee and foreman sign the sheet which is then returned to the personnel office for filing in the employee's folder. A similar system exists for mill employees.

RADIATION. Radiation protection is carried out in both the mines and the mill. In all uranium mines, radon gas emanates from the ore and is removed by the circulation of fresh air. To ensure that the gas is kept within the limits set by the U. S. Department of Health, samples are taken in all mines at monthy intervals and monthly ventilation surveys and reports made. Included in the radiation protection for mill employees are film badges to check the external radiation, routine urinalyses of all employees, the wearing of respirators in certain areas, and periodic sampling of the drinking water. Results of all surveys and tests have proved satisfactory.

PROTECTIVE EQUIPMENT AND EYE PROTECTION. Throughout the whole operation, employees wear hard hats and hard toe footwear. In the mill, a 100 percent eye protection program is in existence. The mines present a different problem, due to wet conditions, and to date about a 60 percent coverage exists. An all out effort is being made to increase eye protection to a higher percentage, as operating conditions permit.

ACCIDENT PREVENTION COURSES. Virtually all mine supervisors (from shift boss level and up), have attended and passed the U. S. Bureau of Mines accident prevention courses. Arrangements have been made with the Bureau to give a similar course to employees below the supervisory level in the future.

FIRST AID AND MINE RESCUE TRAINING. A large number of employees have been trained in first aid. The Company has its own instructors and examiner; 12 employees have been trained in mine rescue operations.

FIRE PROTECTION. Both the mines and mill are well equipped with fire fighting equipment. Fire fighting procedures with five trained fire fighting crews are in existence in the mill. A procedure for fighting underground fires is being worked out.

INCENTIVE PLAN. Two types of award systems are included in the incentive phase of the safety program. They are the unit award and the individual awards. The unit award is given if a mine crew works without a Lost Time Accident for five (5) months or the mine surface department works without a Lost Time Accident for eight (8) months or the mill works 250,000 man hours without a Lost Time Accident. When a crew wins an award, all the employees in the group concerned are given a safety dinner and an award. Individual awards are given to any employee who works without a Lost Time Accident for a continuous length of time which is six months for steady underground workers, nine months for part time underground workers such a Geologists, Engineers, Mechanics and Electricians and twelve months for surface workers.

FULL TIME SAFETY DIRECTOR. The safety director's job is an advisory, staff-type job. His place in the organization is directly under the general manager to whom he is responsible. In cases of emergency where life or property is in imminent danger, he has the authority to stop the operation in question. The job of keeping the first 12 points of the safety program going and of coordinating them is one of his duties. Other duties which he performs include inspection work, advisory work, investigation of accidents, liaison with the doctors caring for injured employees, liaison with the workmen's compensation insurance carrier, and the keeping of compensation and safety records and statistics. These multiple duties and the fact that the mines and mills are about 17 miles apart, require a full time safety director and a secretary.

The effectiveness of the program can be substantiated by stating some of the records achieved. One underground mine has worked over 800 days with only two small lost time injuries and has earned four unit awards. The mine surface department has won two unit awards. The mill worked over 250,000 man hours and celebrated its award with a dinner.

At the end of February, 1961, another record was achieved in the Ambrosia Lake area by the employees of the Homestake-Sapin Partners. The entire operation, (mill and three mines) worked five calendar month—October, November, December, January, and February, without a lost time injury.

In the past, considerable adverse criticism has been aimed at the safety programs in the Ambrosia Lake district but Homestake-Sapin Partners with its safety program participation and cooperation of supervisors and employees, plus managerial support has proven that uranium ore can be mined underground safely in this area. END

HOMESTAKE SAPIN PARTNERS

To ..... Section No. ..... Date .....

This will introduce Mr. ....., Employee No. ..... who has completed all pre-employment requirements. He is reporting for instruction in the items listed below. As each item is explained and understood, please so indicate with an "x" in the space provided. Upon completion of the "Job Instruction," please sign his "Permit to Work" and refer him to (Mine Foreman or Shift Boss) ..... , Section ..... so he may begin his duties as (Job Classification .....

Personnel Department

JOB INSTRUCTION AND PERMIT TO WORK

THE SHAFT
1. **Cage**
   a. Loading and unloading ____
   b. Entering and leaving ____
2. **Bell System**
   a. Call bell ____
   b. Cage bell ____
3. Dangers of open shaft ____
4. Use of safety belts and ropes ____

MOVING EQUIPMENT
1. Battery locomotives and mine cars ____
2. Signal lights ____
3. Eimco loader ____
4. Wagner loader ____
5. Getman trucks ____
6. Go-cart ____

STATIONARY EQUIPMENT
1. Slushers ____
2. Tugger hoists ____

CHUTES
1. Drawing ____
2. Barring down ____

ROOF CONTROL
1. Explain type of ground ____
2. Roof bolts, mats, chain fencing ____
3. Timber support ____
4. Use of roof jacks ____
5. Barring down practice ____

SLUSHER TRENCHES
1. Dumping procedure ____
2. Guards ____

EXPLOSIVES
1. Blasting Procedure, Times, etc. ____
2. Transportation ____
3. Underground storage ____
4. Handling ____

FIRST AID SUPPLIES
1. Location ____
2. Recording Book ____

FIRE EQUIPMENT
1. Location and use of extinguishers ____
2. Location and use of hoses ____
3. Procedure for reporting fire ____

INDUSTRIAL INJURIES
1. Procedure for reporting ____
2. Treatment by physician ____

MISCELLANEOUS
1. Safety glasses ____
2. Use of mine telephones ____
3. Escapeways ____
4. No smoking regulations ____
5. **Electrical equipment**
   a. Switch boxes ____
   b. Transformers ____
   c. High voltage lines ____
6. Ventilation ____
7. Additional instruction (Ask Shift Boss) .....

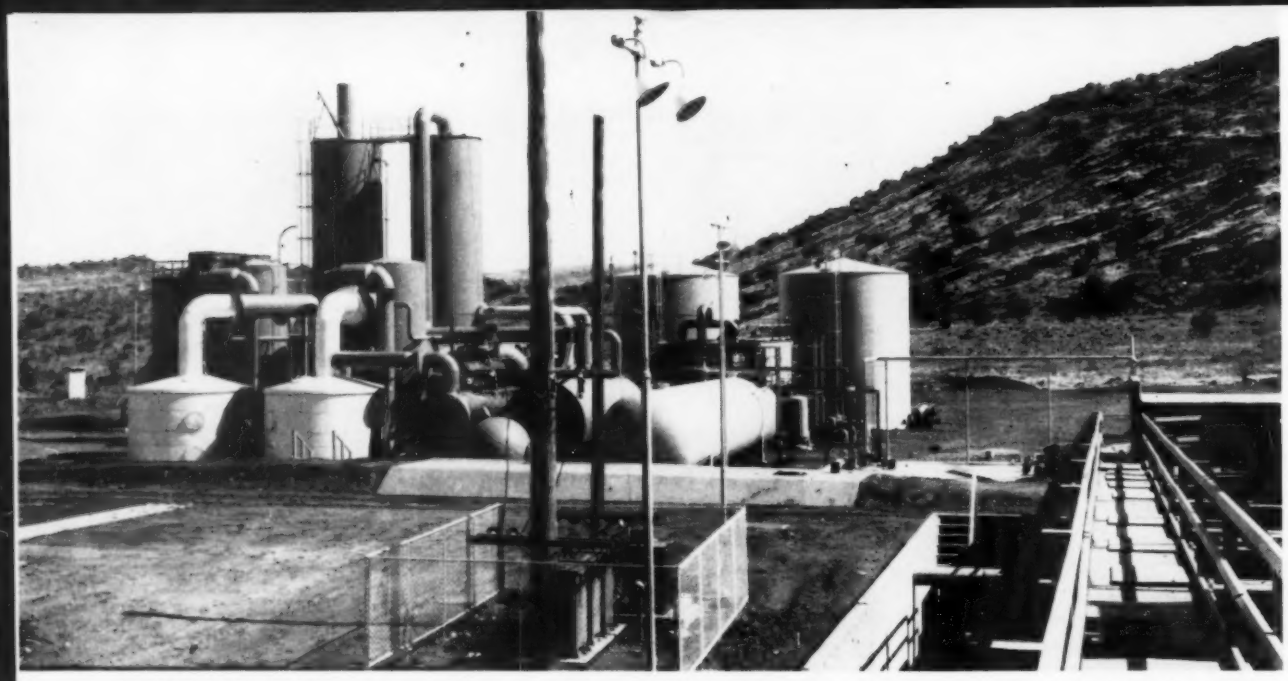
This is to certify that I have received instruction in all items listed above.

Date ..... Employee's Signature .....

The above named employee has completed his "Job Instruction" and has been referred to his Mine Foreman for regular work.

Mine Foreman

SAFETY TOUR FORM is checked by all new employees during an indoctrination tour before they go to work. Each employee and the mine foreman sign the form.



SULPHURIC ACID PLANT converts molten Texas sulphur to 98 percent pure H_2SO_4 at rate of 200 tons per day. Plant, precipitating launders, and surge pond are located on a small mesa two miles northwest of Bagdad open pit.

New Leach Plant Ups Bagdad's Copper

A $2,000,000 acid-leach-precipitation plant recently increased production for Bagdad Copper Corporation to about 100,000 pounds of copper per day. Oxide stockpiles are now irrigated with dilute acid, and the solution pumped to launders where tin cans precipitate 40,000 pounds of cement copper daily

by **John R. Bogert**
Field Editor, Mining World

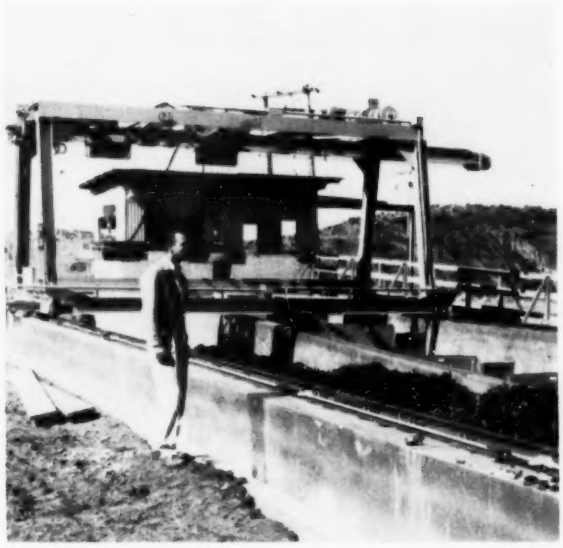
Last year copper production in the State of Arizona reached an all-time high of 539,300 tons—and in 1961 it will probably be higher. Contributing in no small way to this greater output will be the Bagdad Cooper Corporation of west central Arizona who recently upped copper production from 60,000 to 100,000 pounds a day—a whopping 67 percent increase! This big production jump is due solely to round-the-clock output of a new cement copper operation that includes the largest sulphuric acid plant in Arizona, and the largest Koroseal plastic-lined surge pond in the world. These and other aspects of this modern recovery operation have attracted the attention of engineering men from all parts of the United States.

Bagdad operations have always been based on disseminated sulphide ore which occurs in a relatively thin irregular zone underlying oxidized capping. A 5,000 ton-per-day flotation mill effectively concentrates this ore, and concentrates are sold to the American Smelting and Refining Company's smelter at Hayden, Arizona. However, minor copper values in the extensive oxidized overburden has always been noticed and appreciated.

As early as 1926 J. W. Hutchinson in a report on the then undeveloped Bagdad prospect made special note of the 70,000,000 tons of oxidized overburden carrying at least six to eight pounds per ton of acid soluble copper, and said it was "of fundamental economic importance to your company." Thus, it is no wonder that starting in 1946, when mining operations at Bagdad were converted from underground to open pit, that the oxidized stripping was carefully stockpiled in two dumps. However, it was not until 1959 that a method of heap leaching was decided on, and the decision made by management to go ahead.

At Bagdad, since there are no sulphide minerals in the dumps, it is impossible to successfully leach with water alone. Thus, an acid plant was

PIPELINES carry acid solutions to and from dumps in background—Mineral Creek to left, Alum Creek to right.



PRECIPITATING CELLS, charged with shredded tin cans by automatic loading device, are inspected by Bob Bogart.

Production by 67 Percent

the main item of the new project.

The sulphuric acid plant construction was begun in 1960 by the Fisher Contracting Company of Phoenix, with design and engineering work done in collaboration with the engineering staff of Bagdad. The 200 tons-per-day plant was completed in March, and started operating in May. The plant, nearby precipitating launders, and surge pond are all located on a small mesa approximately two miles northwest of the Bagdad open pit. This was the only flat area available reasonably close to the dumps.

Heap leaching at Bagdad has its beginning with the purchase of molten sulphur in Louisiana from the Texas Gulf Sulphur Company. This is delivered in tank cars to the Santa Fe railroad siding at Hillside, Arizona, 28 miles southeast of Bagdad. Since the sulphur becomes partly solidified in transit, a special steaming plant at Hillside is used to empty the tank cars and return the sulphur to a molten state. Dickie Trucking Company trailer tank trucks then carry the molten sulphur to underground storage at the acid plant at Bagdad. The insulated underground tank has a capacity of 250 tons, and is equipped with steam lines to keep the sulphur continually molten.

The process of converting the sulphur to sulphuric acid is semi-automatic. It is controlled by one man from a Minneapolis-Honeywell color-guided schematic instrument panel where flow, temperatures, and pressures are automatically and continually recorded.

Produces 200 Tons Acid Daily

Molten sulphur from underground storage is transferred by air pressure to a horizontal charge tank. It is then pumped to a sulphur burner where, together with dry air from a vertical drying tower, SO_2 gas is generated. This gas goes to a waste heat boiler, through a heat exchanger, and to the first converter. This converter has two masses of vanadium pentoxide which act as a catalyst in converting the SO_2 to SO_3. After returning through the heat exchanger, this last step is repeated through a second converter when conversion to SO_3 gas is theoretically complete. The SO_3 gas then passes through a cooler to an absorption tower where moisture (from the drying tower) is absorbed until sulphuric acid of 98 percent purity is attained. Excess SO_3 is released into the atmosphere. Operating continually this efficient plant produces 200 tons of H_2SO_4 acid per day which is stored in two 750-ton storage tanks.

Sulphuric acid from the storage tanks starts its work in the leaching operation at two small 890,000 gallon conditioning ponds near the precipitating launders. Here, acid is added to barren solution coming from the launders, bringing it up to a strength of seven and a half grams acid per liter of water. This lixiviant then flows by gravity through a 4,500-foot long, 14-inch diameter pipeline to the leach dump. This pipeline is made of stainless steel lined with polyvinyl chloride plastic.

There are two multi-million-ton dumps at Bagdad that will eventually be treated by heap leaching. The largest dump is the Mineral Creek; the smallest the Alum Creek. Dump material is altered monzonite porphyry, mine run in size, containing approximately 0.435 percent acid soluble copper in the form of malachite, azurite, and a little chrysocolla. Present plans call for leaching only the Alum Creek dump.

The top of the dump is divided into a series of connected ponds 100 feet square and approximately one foot deep. These shallow ponds control the distribution of the dilute sulphuric acid solution. By a system of rotating the flooding of the various ponds an even application of leach solution is applied which percolates through the dump.

Although the dump material is relatively free from acid-consuming constituents other than copper miner-

als, it is anticipated that approximately 30 percent solution losses will occur. Thus, of 4,800 gallons a minute irrigated on top of the dump, only approximately 3,350 gallons of copper-bearing pregnant solution reaches the collecting pond at bottom. This is because of natural evaporation, absorption by the dump material, and seepage into the ground.

The collecting pond at the bottom of the dump is formed by a small concrete dam which also supports a pumping station. On top of the dam two United States pumps are presently installed, with two more to be added when leaching of the nearby Mineral Creek dump begins. The existing pumps are equipped with 400 horsepower vertical turbine Ideal electric motors, and each pump up to 1,800 gallons per minute.

From the collecting pond, the copper-bearing solution is pumped uphill through another plastic-lined pipeline to the leach plant on the mesa. The pumping distance is 4,500 feet and the vertical lift 650 feet. Here, close to the sulphuric acid plant, the pregnant solution (containing copper sulphate) is discharged from the pipeline into a special plastic-lined surge pond.

The 1,400,000-gallon pond is unique and the largest of its kind in the world in industrial use. It is 264 feet long, 114 feet wide, 7 feet deep, and the bottom completely covered with an aluminum-coated Koroseal polyvinyl plastic sheet made by B. F. Goodrich. The pond was simply scooped out of the earth, and has no special base other than the plastic sheet which is 280 feet long, 130 feet wide, and 8 mills thick. It is impervious to most chemicals, mildew resistant, and will last indefinitely with proper care.

From the plastic-lined surge pond the copper-bearing solution flows by gravity to the nearby precipitating launders. Here, at a flow rate of 3,350 gallons per minute, the solution containing copper sulphate circulates through a series of cells containing shredded tin cans. Since the iron has a greater affinity for the sulphate radical than the copper, the iron is slowly dissolved and the copper precipitated in the form of the dark brown mud called cement copper. There are a total of 10 double precipitating cells 9½ by 10 by 30 feet deep, made of reinforced concrete. A stainless steel screen is placed 13 feet down from the top of each cell to hold the shredded tin-can scrap.

Launders Charged Automatically

The cells are charged with an overhead three-ton semi-automatic loading device made by Shaw Box. Two 48-inch Schrader magnets designed for shredded iron move back and forth keeping the cells filled, from a three-day storage supply alongside the launders. Each magnet has a load cell which sends information to a totalizing device that keeps a record of the tonnage deposited in the individual cells. The loading device requires an operator for starting and stopping only.

For each pound of cement copper produced one-and-one-half to two pounds of burned, shredded tin cans are needed. These are purchased from Las Vegas, Nevada (300 tons a month); Phoenix, Arizona (100 tons a month); and Los Angeles, California (6,700 tons a month).

As the shredded tin in the cells is replaced by copper, the mud precipitate settles to the bottom and is pumped to a holding cell at the head of the launders. This pumping is done with 10 Worthington pumps (one for each two cells) powered by General Electric Tri-Clad induction motors. From the holding cell the cement copper mud is then pumped by another Worthington unit to a 2,200 revolution-per-minute Bird centrifuge that dewaters the precipitate to 15 percent moisture. Overflow from the centrifuge goes back to the precipitating cells.

From the centrifuge the dewatered cement copper drops onto an 18-inch wide Hewitt-Robins conveyor that carries it 20 feet to a concrete loading pad. Here, a 1¼-yard Hough Payloader loads tractor-trailer trucks that take the cement copper (averaging 70 to 80 percent Cu) to the Hillside railroad siding. From there it is shipped to the American Smelting and Refining Company smelter at El Paso, Texas.

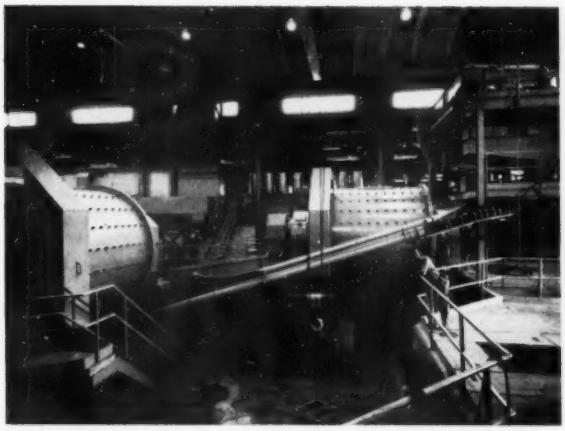
At the end of the launders the barren acid solution, now devoid of copper, flows by gravity to two 500,000 gallon conditioning ponds. Here, fresh sulphuric acid is added to bring it up to a strength of 7½ grams acid per liter of water, and the dilute solution is again sent to leach the oxide dump. Acid consumption in the circuit is approximately 10 pounds acid for each pound of copper.

Water for the acid-leach-precipitation operations is piped from Burro Creek, some seven miles away. During dry summer months, though, this small creek dries up, so deep wells in the area have become the sole source of supply.

The entire operation is run by supervisor Edward S. Howell with one man each at the control panel, acid plant, and precipitation cells; plus two maintenance men, and one clean-up laborer. The general manager of all Bagdad operations is George W. Colville, assisted by Robert C. Bogart. END

UNIQUE plastic-lined surge pond holds 1,400,000 gallons, is largest of its kind in the world, and is estimated to have lowered construction costs by about $24,000.

ALUM CREEK DUMP is smallest of the two large stripping dumps that contain an estimated 0.435 percent acid soluble copper. Photo taken prior to leaching operations.



GRINDING CIRCUIT has 350 tons per hour capacity. Rod mill at left is in open circuit. Ball mill is closed with Krebs cyclones for a 50 percent minus-200-mesh grind.

LEAD ROUGHER flotation section in foreground. Inclined ramp at left makes fork lift delivery of supplies possible to all floors. Stainless steel reagent tanks are grouped in center.

St. Joe's Viburnum Mill . . .

How staff planning, engineered design, and modern equipment make this today's most highly automated lead flotation mill

When a company has a top-level design and engineering group, a well staffed metallurgical research department, an ingenious mill operating crew, and a cost conscious management that have all cooperated to built two major lead mills in the last 10 years it knows about milling lead ore.

That's why St. Joseph Lead Company's new 3,000 ton per day flotation mill at Virburnum, Iron County, Missouri, has been termed the world's most modern lead flotation mill.

This mill strives for perfection, but nothing is perfect and St. Joe's staff is adding new equipment and improving operating results daily. Witness the automatic conveyor belt stops recently installed under the tramp iron magnets in the crushing plant.

You know too that the next mill St. Joe's staff will design and build will incorporate these as standard equipment to stop the belt as soon as a piece of tramp iron, caught and held by magnets, cuts through the belt.

The new Virburnum mill was no crash program, no hurried design job with a non proven flowsheet.

The staffs have "kept books" on mills for years. Both the good equipment and results, and more importantly the bad.

Since Indian Creek, which was St. Joe's last mill, 2,400 tons per day, was started in 1954 a careful record book has been kept. When the staff found a better way to do something, or saw where an improvement could be made they were logged in the book.

In 1957, after thousands of diamond drill holes had proven a "New Lead Belt" 40 miles to the west of the world's second largest lead district—Southeast Missouri —the decision was made to build a 6,000 ton per day central Virburnum mill. It would treat ore from three different mines each having two separate ore ownerships. The first of what will eventually be two identical 3,000 tons per day circuits went into operation in late 1960.

The mill was built at No. 28 mine where ore is hoisted directly from underground to the primary mill bin. Ore from No. 27 the first in the New Belt (See July MINING WORLD), is trucked to the mill bin.

By looking carefully at the "Mill Book" the staff knew what to do to make Viburnum its best mill. Here are the reasons that it is such an outstanding mill and has already attracted leading metallurgists from as far away as Katanga, Broken Hill, Vasbo, and San Francisco.

Design and Engineering

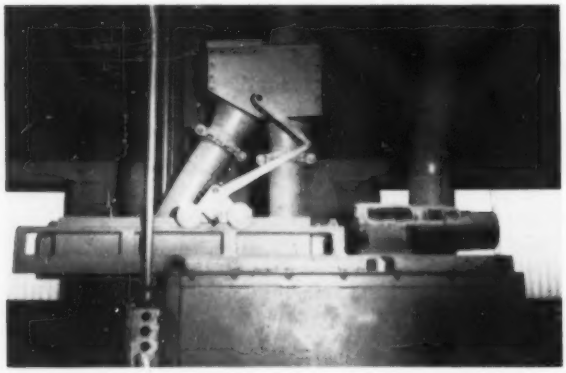
Detailed design was done by the General Engineering Company of Canada, Ltd. to the specifications and general flowsheet set by St. Joe's staff. General Engineering left one of its so called "trademarks" at the mill, too. This is the self supporting circular conveyor gallery leading to the fine ore bins.

The mill was planned and laid out for a maximum capacity of 6,000 tons per day. However duplicate crushing and screening foundations were poured so that this capacity could be doubled. Foundations for two additional 3,000 ton fine ore bins were poured and in the mill building proper all foundations have been completed for the second 3,000 ton section of duplicate grinding, flotation, and filtering units. Flotation and filter foundations have been completed also for the zinc circuits which can be added to either or both of the lead circuits.

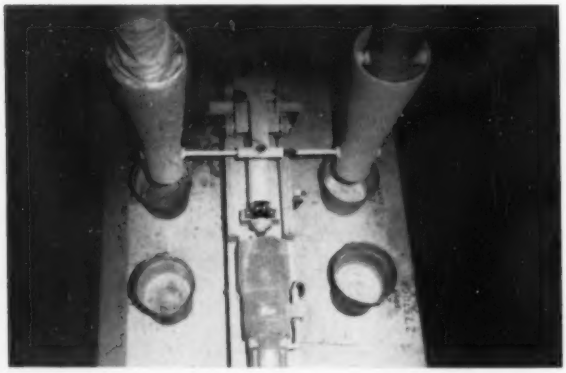
During initial operation the only ore mineral is galena so the mill was constructed to recover galena only. Assays of cores had, however, shown that in several sections to be mined in the future that sphalerite will be an important byproduct. In addition, chalcopyrite in certain beds may well be present in sufficient amount to justify

Sample Plant Automation . . .

CRUSHING PLANT control panel. Operator easily switches from company to government ore by setting proper knob. Relay lights show which pieces of equipment are operating. Weight of ore being crushed is recorded on this panel from Weightometer on belt to fine ore bin.



AUTOMATIC FLAP GATE is actuated from panel shown above to switch sample cut as the source of ore is changed at primary crusher. Electrically actuated thruster at right positions gate through track mounted linkage to cap and close one circular feed chute while opening the other.



SWINGING FEED SPOUT is another way to direct sample cut from the master control board. Government ore sample is collected at right from either of two sources. Mill head feed from either of two mines is collected at left. Picture shows mill feed from No. 28 Mine.

its recovery. Knowing these facts the mill was designed for the recovery of lead first and foremost and zinc and copper in the future.

Mechanized housekeeping has been designed into the mill. A very large central sump has capacity to hold all in-process pulp in the unlikely event that a major overflow or spillage migh occur. The sump can be pumped out and the pulp returned to the ball mill circuit for recovery.

The grinding and classification equipment were placed on extra high foundations and the service piping and manway floor gratings built up and around them. This was done to give plenty of headroom and maneuverability room under the machinery and around the pier foundations for mechanized front end loading equipment to operate. Fast low cost cleanup is the result.

A simple inclined bar grizzly was built right into the launder receiving the rod mill overflow. We all know that any rod mill overflows short broken pieces of rod, extra hard pieces of waste rock in the feed, and occasional chunks of ore. We all know that any of these can quickly wreck a pump. The inclined grizzly is an effective trash screen ahead of the pump. Pulp rushes through, oversize slides to a shelf at the foot of the grizzly where it is out of the way and does not block pulp flow. This trash is easily cleaned off shelf by mill operator and discarded.

The warehouse and machine shop are built at a slightly higher elevation than the top of the mill in which the floor elevation is lowered in three successive steps. This by no means makes the flow in the mill all gravity, but it does simplify machinery arrangement and pulp flow.

An inclined ramp from the warehouse to the lowermost mill floor was built along the westernmost wall inside the building. Battery electric fork lifts easily negotiate this ramp between floors to deliver spare parts and supplies to any part of the mill. Overhead cranes can then quickly lift any replacement parts to machines.

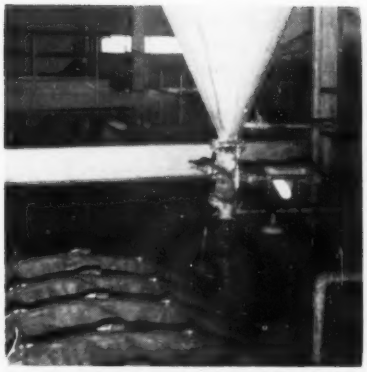
Reagents are purchased in large lots and stored in a separate room on the lowermost mill floor. They are mixed to desired strength in 300 to 1,400 gallon concrete vats. The properly mixed reagents are then pumped to a series of 150 gallon stainless steel tanks above the flotation floor. Reagents are metered to desired circuit strength by stainless steel Clarkson reagent feeders. By placing the storage and mixing area below the flotation section there is no danger of overflow or spillage into the circuit to create a metallurgical problem. The top of each mixing vat is at floor level so that dry or wet reagent contents of drums, barrels, or bags flow by gravity into vat instead of having to be lifted and dumped into a tank.

Advanced Automation

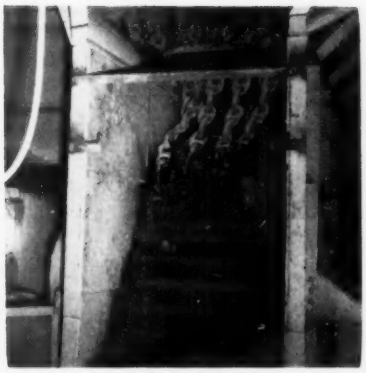
Automation of the sampling plant is described and pictured. The grinding-classification circuit is automated so that an optimum circulating load is maintained in the ball mill-cyclone circuit. This assures the maximum feed (tonnage) of properly ground pulp to the flotation circuit regardless of the size, hardness, or weight of the rod mill feed.

The optimum circulating load is set at approximately 250 percent of rod mill feed and this figure overrides the control room's manually set feed rate to the rod mill. The weight cell pictured and described separately is the key to automation. The greater the weight of the cyclone underflow the denser the pulp and the greater the circulating tonnage. As this weight increases over the 250 percent factor the feed is cut back to the rod mill. A Transweigh scale on the rod mill feed conveyor is manually set at certain tonnage and maintains this tonnage by regulating the belt speeds drawing ore from fine bins.

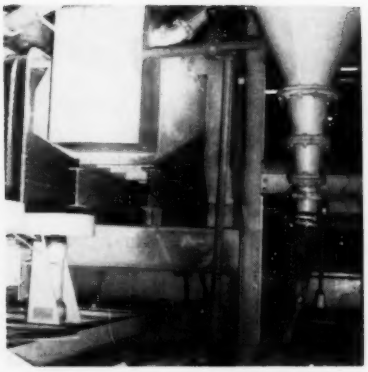
Flotation feed is cyclone overflow and is held at a



RUBBER PINCH VALVE on bottom of lead concentrate dewatering cone is automatically opened and closed to assure correct filter pulp level for Eimco disc filter. Electronic probes in the filter tank are used for level control. Dewatering cone cuts size of thickener for concentrate dewatering.



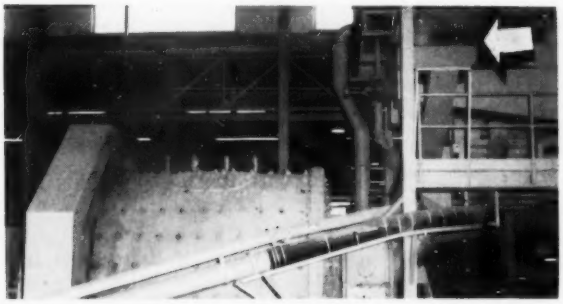
DROP BAR DRUM FEEDER made in St. Joe's shop is used to control feed rate to primary crusher. Feeder acts as grizzly, too, with fines dropping directly to belt. Nominal speed is 1.0 revolution per minute, but can be changed by a Reeves variable-speed drive to achieve the desired feed rate.



MAINTAINING SUSPENSION of lead cleaner tailing in distribution cone is achieved by pumping the tailing from the flotation cells at lower left into the bottom—not the top—of the cone. There is an extra bonus by saving eight feet of head on the pump which cuts power requirements slightly.

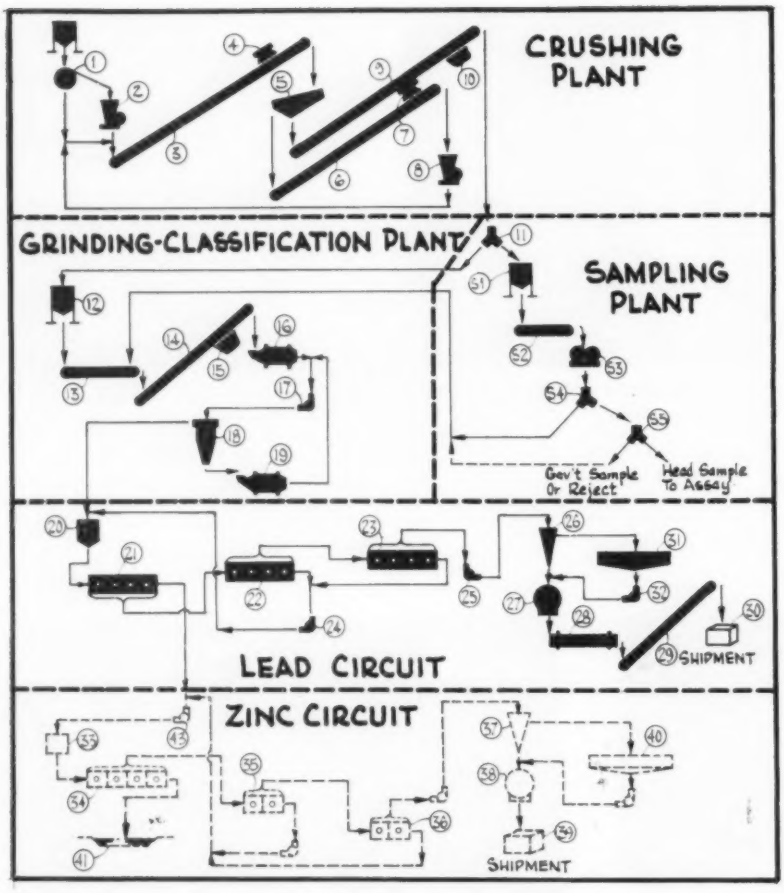
TWIN GATES under each fine ore bin assure close control of draw and better bin emptying than does the conventional single gate. Screw gate on each side is manually operated for approximate feed rate. The individual belt shown here discharges to main conveyor (running at right angles) which extends under two bins. This belt is driven by a direct current motor for close control of belt speed and hence the bin draw off rate.

TRAMP IRON is quickly and easily removed from electric magnet suspended over 48-inch wide No. 1 primary conveyor belt. Note how magnet is suspended for two way travel. Magnet is moved to right to get it closer to belt. This entire assembly can be moved over the stationary rail track to left to a position alongside belt. Power is then cut and magnet drops scrap and trash into wheel barrow. Belt is not stopped to clean magnet.



BALLS ARE CHARGED into ball mill through inclined chute at upper right which leads directly into feed end. Balls are stored in bin at point from where photograph was taken. They are transferred in special bucket from bin to chute by overhead crane. Trucks dump balls directly into bin from which they flow by gravity to load bucket. Crane operator positions bucket on top of platform indicated by white arrow. As the crane hook holding the special container is lowered the weight of the balls causes the bottom of the container to drop under the weight of the balls.

CIRCULATING LOAD control in grinding circuit operates as follows: Spigot discharge from all operating cyclones flows through covered launder of constant slope and is continuously weighed by load cell. The greater the quantity of spigot product, ball mill feed, the greater weight indicated by load cell. If circulating load rises above set point, normally about 350 tons per hour, the control device cuts rate on new-feed tonnage controller until circulating load falls to set point on circulating load controller. If circulating load is below the set point the corrections are made in reverse order.



Viburnum Flowsheet and Equipment Legend

CRUSHING PLANT

1. Drop bar drum feeder and grizzly. Reeves variable-speed drive
2. Primary crusher, Telsmith B-25, to minus-4-inches
3. No. 1 conveyor belt, 48-inch
4. Electric magnet, Magnetic Engineering and Manufacturing Company
5. Vibrating screens, two Nordberg, 5- by 10-foot with ⅝-inch cloth. Undersize to No. 3 belt to fine ore bins. Oversize to No. 2 belt to cone crusher
6. No. 2 conveyor belt, 36-inch
7. Electric magnet, suspended
8. Secondary crusher, 7-foot Symons set at ⅝-inch
9. No. 3 conveyor belt, 36-inch
10. Weightometer, Merrick

SAMPLING PLANT

11. Full stream sampler, Denver, makes 0.043 percent cut
S1. Sample bin, 1-ton
S2. Belt feeder
S3. Roll crusher, Denver, 16- by 10-inch
S4. Sampler, Denver, makes a 2.8 percent cut
S5. Splitter, pulps for assay, each is 0.000301 percent of crushed ore to mill bin

GRINDING—CLASSIFICATION

12. Fine ore bins, two, each with 3,300 tons capacity
13. Ore feeders, two under each bin with variable-speed drive
14. Conveyor belts, one under bins feeding main belt
15. Scale on belt, Transweigh
16. Rod mill, 10.5- by 14-foot Allis-Chalmers driven by 700-horsepower motor. 14 rpm. Charge, 153,000 pounds of 3-inch rods
17. Pump, Pettibone Mulliken model 8MO24
18. Cyclones, four Krebs DW-20, one as standby
19. Ball mill, 12- by 12-foot Allis-Chalmers driven by 800-horsepower motor. 14 rpm. Charged with 112,000 pounds of balls

LEAD FLOTATION CIRCUIT

20. Four-way pulp distributor
21. Rougher flotation, 28 60-inch Wemco Fagergren cells
22. Cleaner flotation, 4 48-inch Wemco Fagergren cells
23. Recleaner flotation, 4 48-inch Wemco Fagergren with one pumper cell
24. Pump, Denver 3-inch SRL
25. Pump, lead concentrate
26. Cone, concentrate dewatering and storage
27. Filter, Eimco with 8 10-foot discs
28. Drier for concentrate, Louisville 7- by 40-foot with agitation baffles. Propane-fired with Fuller Company dust control system
29. Conveyor, shuttle with Transweigh scale, for loading concentrate
30. Steel container, 9-ton capacity, for shipping via truck and railroad to St. Joe's Herculaneum smelter
31. Thickener, 50-foot-diameter
32. Pump, Denver 3-inch SRL

ZINC CIRCUIT

(Designed but not installed)

33. Zinc conditioner where reagents added
34. Rougher flotation, 12 60-inch Wemco Fagergren cells
35. Cleaner flotation, 2 48-inch Wemco Fagergren cells
36. Recleaner flotation, 2 48-inch Wemco Fagergren flotation cells
37. Cone, concentrate dewatering and storage
38. Filter, Eimco disc
39. Container, steel for shipment, same as lead
40. Thickener
41. Tailing pond behind earth-fill dam. Actually the lead tailing is now the mill tailing
42. Pump
43. Pump

constant density by addition of water to cyclone feed. An Ohmart Gamma Ray gauge measures the pulp overflow density and operates the electrically controlled valve.

Staff Makes Improvements

As previously mentioned the staff is constantly seeking and finding ways to make improvements. The major changes take time, but there are many smaller ones which can be easily made without changing the circuits or equipment. Here are typical examples at the rod mill: A shop made Linatex seal has been installed at the feed end to virtually eliminate any spillage. An electrical resistance heater has been "built-in" to the Farval oiling system to insure free flowing oil to all bearings.

Operational Data

As shown in the flowsheet the primary crusher is in open circuit to yield a minus-4-inch product. The secondary cone crusher is in closed circuit with vibrating screens to yield a minus-⅝-inch product.

The rod mill operates in open circuit to overflow a minus-¼-inch grind to cyclones which are in closed circuit with the ball mill. Cyclone overflow is 50 or 55 percent minus-200-mesh with about five to eight percent plus-48-mesh. Cyclone underflow to ball mill is 70 percent plus-10-mesh and less than one percent plus-6-mesh.

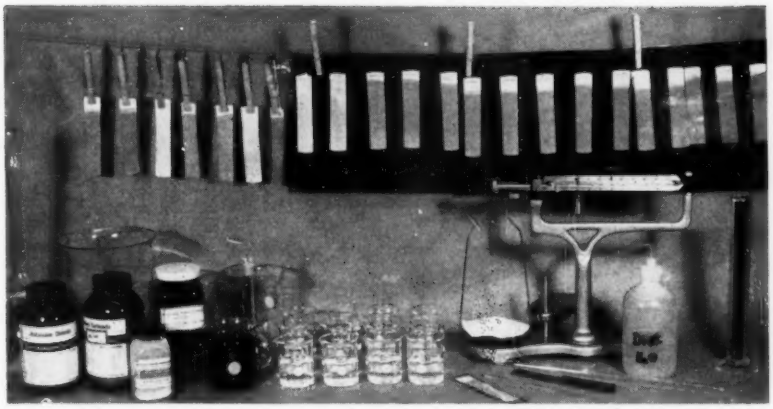
Flotation feed is about 40 percent solids and assays 3.0 percent lead in galena. There are no oxides to complicate flotation and the lead does not slime which makes it possible to achieve a 0.10 percent lead tailing. There are minor amounts of pyrite, sphalerite, and chalcopyrite in the ore presently being milled. In ore bodies yet to be mined the zinc will be floated separately from the lead tailing, and the copper recovered from a bulk concentrate.

Only two reagents are used at present—a frother and a collector—as the dolomite gangue regulates pH control so that neither lime nor soda ash is needed. Frother is Cyanamid No. 77, 0.03 pound per ton, added to flotation feed. Collector is Cyanamid Aerofloat No. 31, 0.09 pound per ton added to rod mill feed.

During its first complete year of operation—1961—this new Viburnum mill will produce about 18,000 tons of lead and together with Indian Creek nearby one-third of all production in southeast Missouri. Viburnum efficiency and recovery are impressive in the world's lead industry. END

Supplies for 80 Determinations Per Day

1	Analytical balance. A triple beam balance may be substituted with some loss of accuracy.
1	Each; spatula, forceps, beaker tongs, stirring rod, and distilled water wash bottle.
1	2-liter Pyrex beaker.
2	600-ml Pyrex beaker.
1	250-ml Pyrex beaker.
80	100-ml Pyrex beakers (one for each determination per day).
1	Graduated cylinder, 100-ml.
1	Volumetric flask, 1,000-ml.
1	Volumetric flask, 100-ml.
1	Serological pipette, 10-ml, 0.1-ml divisions.
80	Clothespins, wood, spring type, with 1/8 inch hole drilled in one side and wire "S" hook attached, to hang up filter paper strips for drying.
80	Filter paper strips, one inch wide and at least four inches long, cut from 12.5 cm S & S Black Ribbon filter paper.
1/4 lb	Potassium chloride, analytical grade.
1/4 lb	Magnesium carbonate or magnesium oxide, analytical grade.
100 gm	Dipicrylamine (2,2′, 4,4′, 6,6′—Hexanitrodiphenylamine) Eastman Organic Reagent No. 4402. Caution: Explosive.



MOST OF THE EQUIPMENT needed to make 80 rapid semi-quantitative potassium assays per day. Equipment for 1,000 assays costs about $80.00. Each assay costs about $0.26 including labor. Note how clothespins are used to hang filter paper strips for drying (left) while standard strips in acetate film are at right. Color differences between standards are not apparent here in this black and white picture.

POTASH ASSAYING fast and cheap colorimetrically

by **J. Kent Perry**

A new method of assaying water soluble potassium in samples is simple for semi-quantitative results. Magnesium dipicrylaminate is the reagent. Large amounts of sodium give negligible interference.

The method is: 1. accurate enough to provide useful preliminary data during exploration; 2. simple enough to be set up in a field laboratory where there is a source of cold tap water; 3. possibly accurate enough for determination of some routine mine samples; and 4. is a cost reducing adjunct to save expensive reagents on chloroplatinate assays knowing the approximate assay first.

By the new system the standard error (68 percent confidence limits) is plus or minus 13 percent. The difference in results between the rapid and chloroplatinate assays, expressed as percent K_2O, is less than 5.0 percent in 93 percent of the assays.

Any criticisms or suggestions for improvement of the new method are welcomed by the author.

Prepare the reagent, magnesium dipicrylaminate, by mixing 100 grams dipicrylamine, 25 to 30 grams magnesium oxide or magnesium carbonate, and about 750 milliliters of distilled water in a two-liter beaker. Place in a water bath and stir frequently. Remove from the water bath after three hours and let cool. Filter, wash with cold water, and dilute to one liter in a volumetric flask. The reagent does not deteriorate on standing and can be stored for at least six months. It may cause severe skin irritation and it is recommended that rubber gloves or thin, disposable polyethylene gloves be worn when it is used. One liter of reagent solution is sufficient for at least 600 determinations and probably could be for 1,000 without loss of sensitivity.

Standard preparation: Make a 1.0 percent potassium (1 g K/100 ml) stock solution by dissolving 1.928 grams of 99.9 percent pure potassium chloride in about 70 milliliters of distilled water, and diluting to 100 milliliters in a volumetric flask. By using appropriate dilutions, prepare standard solutions containing the following percentages of potassium (weight per volume) in aqueous solution: 0.00 percent, 0.05, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, and 1.0 percent.

Hang the prepared clothespins from a wire or string line and hang a one-inch-wide strip of filter paper, four to five inches long, from the jaws of each clothespin after marking each strip with the potassium percentage to be used. Rapidly immerse each filter paper strip in a beaker of standard solution to within one inch of the clothespin. Do not allow the strips to soak in the standard solutions, but rapidly dip them in and out of the beakers. Allow the strips to dry thoroughly.

Fill a 250-milliliter beaker with magnesium dipicrylaminate solution. Grasp the upper end of a dry filter paper strip with small beaker tongs and rapidly immerse in the magnesium dipicrylaminate solution. Then gently agitate and rinse in a 600-milliliter beaker of cold tap water for 30 seconds. Empty the beaker and refill with cold tap water, and rinse the strip for another 30 seconds. Repeat a total of four times. Thus, the strip will be rinsed a total of two minutes in cold tap water, with four changes of rinse water. This step can be simplified by using two 600-milliliter beakers alternately. The rinsing time and procedure must be kept constant for all standards and samples.

Hang the rinsed filter paper strip from a clothespin again and allow to dry thoroughly. Repeat the procedure for each standard strip. The dried standard strips can be mounted on black paper and placed in acetate photo folders for protection. The standard strips are stable and, once prepared, can be used indefinitely.

Sample Assaying: Potash cores and samples should be ground to minus-100-mesh and mixed thoroughly. For each determination, weigh 1.00 gram of sample and place in a 100-milliliter beaker. Add 49 milliliters of distilled water (approximately 1:50 dilution). Stir until the salines are dissolved. NOTE: If petrographic examination shows that the deposit in question contains large amounts of langbeinite or other slowly soluble potash minerals, the solution must be stirred long enough to insure that such slowly soluble minerals will be taken into solution. Otherwise, results will be low. Some insoluble residue, such as anhydrite, is to be expected in many samples.

Mark filter paper strips with sample numbers and hang from clothespins. Rapidly dip the filter paper strips in the beakers of sample solutions, and allow to dry thoroughly. Proceed with exactly the same procedure used for the standard strips, described above.

When the sample strips are dry, match them with corresponding standard strips in indirect daylight. If the standard strips are mounted in acetate folders, the sample strips should be placed behind a strip of the same plastic during comparison to compensate for any color absorption by the plastic. Persons with good color discrimination will be able to interpolate between standard increments in many instances.

Multiply the standard match by 50 to obtain the weight percent of potassium in the unknown. The percent K_2O in the unknown can be obtained by multiplying the percent potassium by the gravimetric factor 1.2046.

Comparison of results on 10 samples selected at random from about 150 pulps an assayed by both methods for K_2O are as follows:

Sample No	*Percent K_2O By New*	*Percent K_2O By Platinate*	*Difference, Percent K_2O*
95	4.8	8.3	−3.5
96	27.1	24.0	+3.1
102	22.3	24.4	−2.1
107	18.1	20.1	−2.0
108	25.3	26.7	−1.4
110	21.1	22.0	−0.9
114	30.1	29.8	+0.3
117	1.8	1.8	0
118	19.9	21.2	−1.3
119	1.2	2.3	−1.1

The author is indebted to Mr. Arthur Thompson, of the Delhi-Taylor Oil Company, for permission to use potash core samples that had been previously assayed by the chloroplatinate method. END

Mr. Perry is a geological engineer on the staff of the Colorado School of Mines Research Foundation, Golden, Colorado.

ENGINEERS turn photographer and author for this special Mining World report. C. B. Berglund, far left, took the photographs. Next is A. R. Kinkel who wrote the text. With them are Dr. H. J. King from England and E. L. Healy of Canada.

ANACONDA'S Richard Newlin, right, talks with Canadian R. L. Smith at Broken Hill, lead-zinc mine N. Rhodesia.

Commonwealth Delegates Impressed by

Text by: **Arthur R. Kinkel, Jr.**
United States Geological Survey, Washington, D. C.

Photographs by: **Carl-B. Berglund**
Atlas Copco, Stockholm, Sweden

KITWE, FEDERATION OF RHODESIA AND NYASSALAND

After three weeks in the Union, 450 of the original 900 delegates to the Congress continued the tour with a week in Northern Rhodesia and a week in Southern Rhodesia. In a massive airlift of six Viscounts, delegates were moved from Johannesburg to Kitwe in the heart of the Copper Belt. This was one of the most pleasant weeks of the tour; as hotels at Kitwe had only limited accommodations, delegates were divided among the four beautiful townships of Roan Antelope, Rhokana, Mufulira, and Nchanga, and assigned to the homes of the mine officials. Tours were available to all the copper mines, each delegate visiting five mines, and an air lift to the Broken Hill mine was arranged.

Even though production figures and reports have been available on the Copper Belt for many years, most of us who had not visited the area before had not realized the extent and continuity of the ores. Mining methods and plant needs can be laid out with assurance far in advance, for in many of the ore-grade sections now being mined in the lower Roan sediments there is little change in grade or thickness over great strike lengths.

All underground mining is now below the zone of secondary enrichment, which extended from about 150 to 350 feet, but at Nchanga, enrichment is responsible for the high grade of the ore in the open pits. At the Chingola pit, the ore bed is folded back on itself in long flat folds, and leaching of the ore bed in the upper part of the fold has enriched the underlying parts.

Much exploration is being done on the lower Roan ore horizon between the known deposits and in places where folding in the syncline has brought this bed within a few thousand feet of the surface. A number of unknown deposits have been found recently, and many delegates were able to see the laid-out ore section, 50 feet thick, containing 19 percent copper, from a drill hole two miles along strike from one of the mines. Although there are low-grade or barren stretches, the enormous amount of copper in the lower Roan horizon, over hundreds of miles of strike length, has to be seen to be appreciated. Those of us who were used to thinking in terms of low-grade ore had difficulty in adjusting to ore bodies such as the Nchanga West, which contains more than 60,000,000 tons and averages 6.36 percent copper.

Both Anglo American Corporation and the Rhodesian Selection Trust have large, well-equipped research laboratories. The Anglo American center is Rhoanglo Mine Services, Ltd., located at Kitwe, and the R·S.T. center is R.S.T. Mine Services, Ltd., at Kalulushi township. These laboratory centers are equipped on a laboratory and pilot-plant scale for metallurgical and engineering testing, research, and development.

Much work is being done, particularly at Rhoanglo, to improve plant practices by the coordinated use of geologic and petrographic information as it applies to metallurgy. A central technical library is maintained, and a monthly survey of new books and more than 300 periodicals is distributed to mine personnel. These research centers have proved extremely helpful to the mines, and the scope of this work is being enlarged.

Take and Assay 3,000 Daily Samples

Much of Northern Rhodesia is being prospected. Companies can obtain exclusive prospecting rights over large areas, and as a result can plan elaborate and well-designed prospecting programs. Intensive study of aerial photographs with major emphasis on vegetation is followed by reconnaissance geochemical sampling of stream sediments and interfluves in favorable areas. Field parties are serviced where necessary by helicopter. Anomalies discovered are then geochemically sampled in detail along lines 1,000 feet apart, along which vegetation types and soils are mapped in great detail. Some pitting is done

This is the second and final on the scene report from Africa by Mr. Kinkel on the Seventh Commonwealth Mining Congress. His first report in the July issue of Mining World outlined the start of the Congress in Johannesburg and the mine visits in the South African Republic. Publication of these special exclusive reports was authorized by the Director of the United States Geological Survey.

KENNECOTT COPPER was represented by geologist T. N. Walthier in the checked shirt at right. Group discussion was at the Consolidated Murchison (Transvaal) antimony mine.

Copperbelt Mines

for sampling. Anomalies proved at this stage are checked with self potential. Air-borne scintillation-counter surveys are made of some areas, and gravity surveys are in the experimental stage. An area is tested by drilling only after this preliminary work. The method requires a large number of geochemical analyses, with the results available rapidly. In the Rhodesian Selection Trust prospecting, samples are flown daily from field camps to a central laboratory, where 3,000 geochemical samples a day can be analyzed for six metals by chromatographic techniques. Assay values are plotted graphically along the traverse lines by the laboratory as overly strips, and are flown back to the field geologist. Use of helicopters in isolated areas has reduced the cost of this type of prospecting by 60 percent over ground methods, in addition to greatly reducing the time required.

Report on Southern Rhodesia

At the Broken Hill mine of the Rhodesia Broken Hill Development Company, Ltd., the tonnage hoisted appears small by Copper Belt standards. However, the ore is almost solid sulfides containing 23 percent lead and 34 percent zinc. Sulfuric acid is produced from roaster gasses; 2,500 long tons of zinc and 1,200 of lead are produced per month. Construction is well underway on the new ultramodern lead-treatment plant to replace the Newnam hearths now in use. See MINING WORLD, March 1960.

In Southern Rhodesia, tours were available to chrome deposits in the Great Dyke and those off the Dyke, to the Bikita pegmatite, to major asbestos deposits, and to the copper, iron, coal, and gold mines of the area. I had time to visit only the Great Dyke chrome, Bikita, and the Iron Duke, where pyrite is being mined to produce acid.

Bikita Pegmatite—Mineral Marvel

The pegmatite being mined at Bikita Minerals is probably the only pegmatite in the world large enough to be mined selectively by separate open pits on different types of lithium ore. It is a typically zoned pegmatite with unusually large segregations of lithium and cesium minerals in the core area. One large pit is almost entirely in petalite (LiS_4AlO_{10}) in crystals as much as 10 feet long. In another pit a large core area of fine-grained, massive lepidolite ($K_2Li_4Al_2F_4Si_8O_{20}$) containing four percent lithium is being mined. Large core areas of the cesium mineral, pollucite, ($CsSi_2AlO_6$) have also been developed and could be mined if a market was available. Eucryptite ($LiSiAlO_4$) occurs in quantity in several areas, and as it fluoresces a bright pink, it is sorted under ultraviolet light. Beryl ($Be_3Al_2Si_6O_{18}$) is hand sorted.

Large amounts of mixed lithium- and beryllium-bearing ores are available for future mining in an intermediate zone between the core and the outer zone. Pilot-plant metallurgical work has been completed on this type of ore, and it is reported that the different minerals can be separated successfully. Present production rate is from 90,000 to 100,000 tons annually.

Many bands of chrome ore are being mined in the northern 50 miles of the Great Dyke, where the chromite is of metallurgical grade. The African Chrome Mines, Ltd., The Rhodesian Vanadium Corporation, Ltd., and the Rhodesian Mining Enterprises, Ltd., are mining in the area, and produce a total of 17,000 tons of chromite per month.

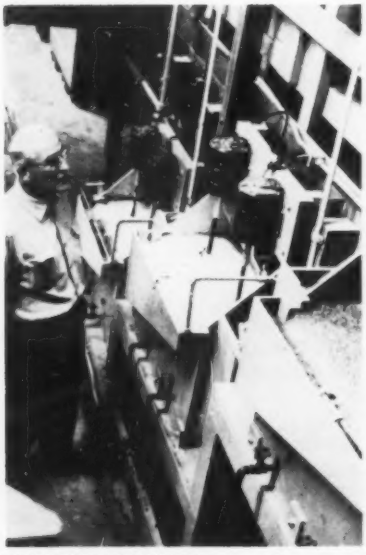
Three seams are generally mined, with an average width of four to six inches each. About 300 miles of strike length on the three seams has been or is being mined, either by surface workings 10 to 50 feet deep or by underground workings.

The companies are also mining eluvial chrome on the bottom slopes of the Great Dyke where weathering has concentrated chromite in a soil layer one to two feet thick on decomposed dunite. The eluvial material averages 30 percent chromite, with concentrations of 50 percent chromite in hollows in the rock surface. The latter are cleaned out by hand with scraper and brush. The eluvial material is washed and screened, only the plus-60-mesh to minus-100-mesh fraction being retained. After scrubbing and conditioning, the chromite is put through cyclones, and the cleaned material is then put through flotation cells where silica is depressed. Flotation concentrate is dried and put over a permanent-magnet drum to eliminate a magnetic, high-iron fraction. Overall recovery is 80 percent, the principal loss being in the fine sizes. Concentrates contain 52 to 54 percent Cr_2O_3 with a 2.8 to 3.4 chrome-iron ratio. Eluvial plants have been in operation only two years, and very large amounts of material are available for treatment along the base of the Dyke, which stands several hundred feet above the valleys.

An account of the Congress must include the thanks of all delegates to the organizers and tour managers who made it possible for us to see so much of the mining industry of Southern Africa. The mining companies, in addition to helping with the organization, hospitality, and financing, went all out to show the delegates all phases of their operations and to answer questions unreservedly. It was particularly helpful to receive at each mine an elaborate brochure containing geologic map, drawings of mining methods, and data on cost, production, reserves, labor, etc., prepared by members of the mine staff. At the speed at which delegates were travelling, they had little opportunity to gather this information themselves.

The Congress was memorable in its scope and technical features, yet I think that the most lasting impression that the delegates took home with them is of the warm friendliness and great hospitality of the mining fraternity and many others in the Union of South Africa and in Northern and Southern Rhodesia. END

BERYLLIUM—Once a scarce metal—now can be recovered from low-grade Utah deposits



FLOTATION CONTROL is most important for beryllium minerals. The pulp can easily be fouled by iron. That's why these cells have rubber lining and impellers. Ore is ground in ceramic-lined mill. A. E. Campbell, plant metallurgist, makes a check of the froth on cleaner cells to determine bubble strength.

BERYLLIUM RESOURCE OFFICIALS check concentrate grade with Boulder Scientific Company's continuous beryllium analyzer. From left are E. Van Dornick, vice president, who developed the reagent combination; M. W. MacAfee, consulting metallurgist, designer of pilot plant; Bruce Odlum, president.

SPOR MOUNTAIN beryllium ore mined from surface looks like whitish-purple dirt. It contains from 0.8 to 1.2 percent BeO as bertrandite—$4BeO \cdot SiO_2 \cdot H_2O$. Ore is sometimes called beryllium bearing clay because of its high montmorillonite content. Large amounts of bentonite are also present.

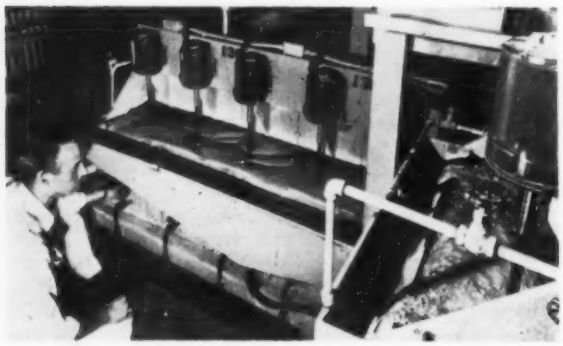
For years geologists have looked for a large low-grade beryllium ore body; mining engineers hoped they would have a chance to develop and mine beryllium ore on a large scale; metallurgists sought a commercial method to float beryllium minerals; and the refinery engineer needed increased ore tonnages so that he could expand his plant for lower cost production.

They all knew that the use of the metal and its alloys would expand rapidly when the price could be reduced by increased production.

Three major technical breakthroughs now point to adequate reserves of ore in the United States which can be cheaply mined, concentrated by flotation, and the beryllium in the concentrates converted to metal at an established plant heretofore exclusively using beryl as the ore mineral.

Beryllium Resources, Inc. has made all three of these breakthroughs. Here are the highlights of the three.

FIRST, development of large tonnages of easily-mineable lowgrade ore in the Spors Mountain in the Thomas Range district of Juab County, Utah. The mine is called the Delta or Topaz Mountain and Beryllium Resources claims reserves of 100,000 tons on the Hogsback claim. The company holds 53 other claims, and leases 10 more. The entire district is thought to contain at least 3,000,000 tons of 0.75 percent BeO. Ore is in rhyolitic tuff in which the beryllium-rich layers may be several

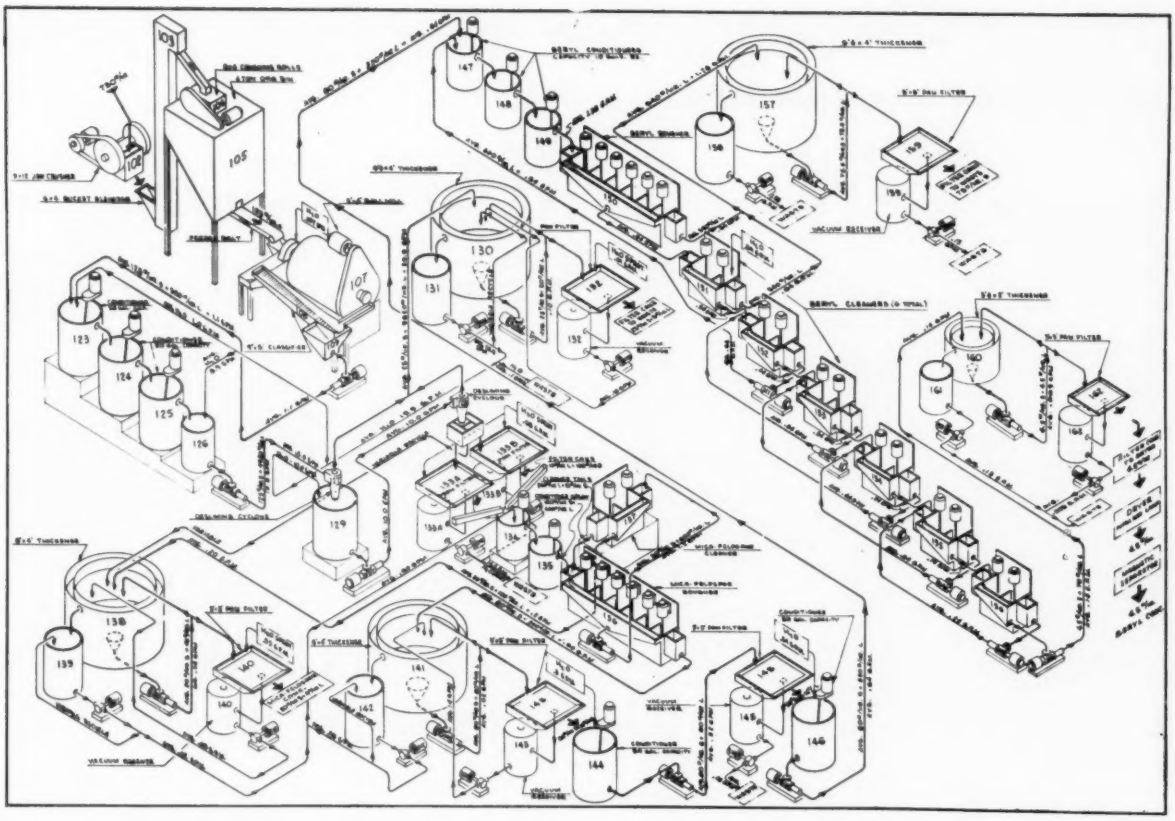


Achieve maximum recovery

Close reagent control in a clean circuit is essential for flotation of Topaz Mountain ore. The most economical concentrate grade in point of recovery and reagent use is about 3.0 percent BeO; higher grade can be made, but with a sacrifice in recovery.

Circuit pH control is critical and the means of regulating it is equally critical. The grinding circuit is maintained at a 9.6 pH and the flotation circuit at 8.3. Minimum collector use is achieved by regulating cell turbulence.

The picture at left shows the primary rougher (left)



COMPLEXITY OF BERYLLIUM mineral flowsheet shows in this diagram. This unit incorporates a separate flotation circuit to remove mica and feldspar from pegmatite ores ahead of beryllium flotation. This section is not used for Spors Mountain ore which is found with many clay minerals in an altered and weathered rhyolitic tuff.

yards thick but are erratically distributed in the same horizon. Bertrandite, $4BeO \cdot SiO_2 \cdot H_2O$, is the ore mineral. Other epigenetic minerals are opal, purple fluorite, calcite, and montmorillinite. Purple fluorite apparently is Beryllium indicator.

SECOND, construction and operation of a successful 150-pound-per-hour pilot plant to recover a beryllium concentrate from this ore. This plant is at 8839 Miner Street, Huntington Park, California.

The clay content of the ore made flotation more difficult because it contained beryllium which had to be recovered. The grinding necessary to liberate the bertrandite resulted in a high slime formation and subsequent chemical leaching to further complicate recovery.

Key to the process is the fact that beryllium minerals form organic compounds with chelating reagents to form a stable base on which to build water repellent and air avid flotation coatings.

THIRD, was the successful production of beryllium metal from the flotation concentrate at Brush Beryllium's Cleveland, Ohio plant.

A 250-ton-per-day commercial mill modeled after the pilot plant will be built at the mine and should be in operation early in 1962.

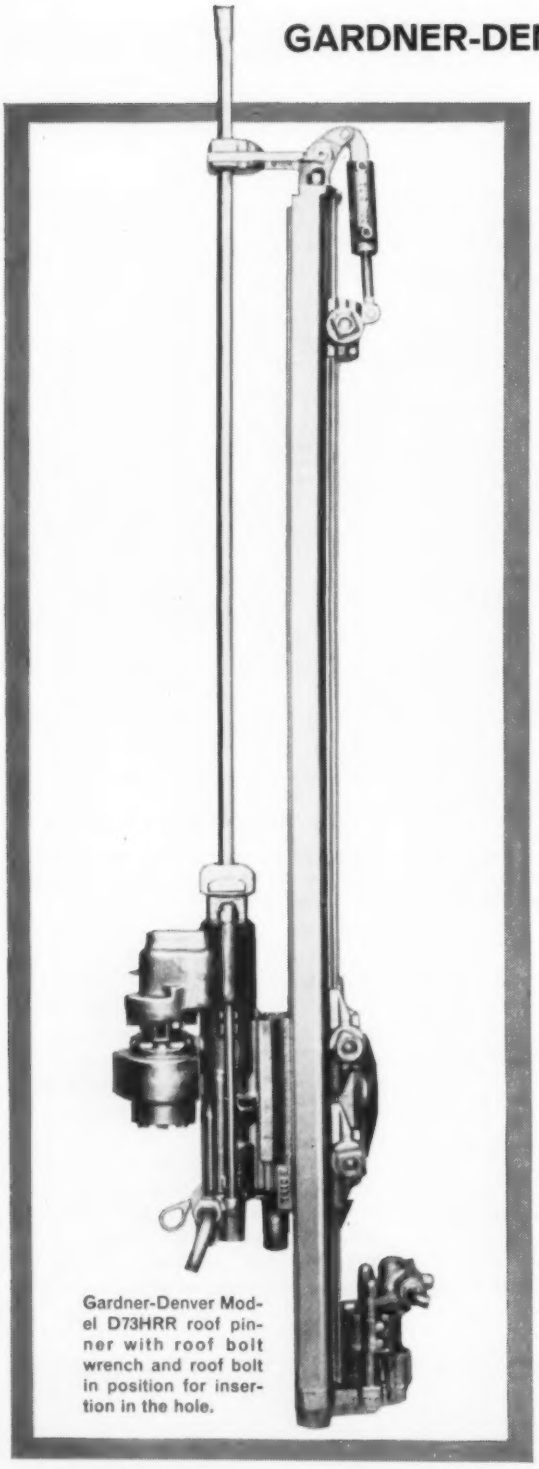
The process works on pegmatitic beryllium mineral, too, and the company is negotiating for mill construction in Mexico, Brazil, Argentina, Mozambique, Southern Rhodesia, and the Republic of South Africa.

by operating clean circuit

and a cleaner at right. Froth stability is a feature of this circuit.

Here are some of the steps taken to maintain a clean circuit; All process water is softened in the tanks and mixed bed demineralizing plant shown in picture at right. The ball mill is ceramic-lined. Mill overflow, 5 percent plus-65-mesh, passes under a magnet to remove iron before it reaches the spiral classifier. All pulp lines are plastic or rubber, flotation cell liners and impellers are rubber to keep iron out of circuit. Sequestering reagents also remove iron from the pulp. END

GARDNER-DENVER MAKES THE NEWS



Gardner-Denver Model D73HRR roof pinner with roof bolt wrench and roof bolt in position for insertion in the hole.

New roof pinner does all 3

1 DRILLS THE HOLE
2 INSERTS THE BOLT
3 TIGHTENS THE NUT

This Gardner-Denver roof pinner does the complete roof bolting job. It's Model D73HRR—your easiest step to simpler, quicker roof pinning.

Ask your Gardner-Denver Mining Specialist for a demonstration. See how the D73HRR remote-control pneumatic centralizer spots hole quickly, keeps the steel in line with the drill. Check all the features:

Powerful, trouble-free hydraulic motor—provides the required rotation speed for drilling in different types of rock.

Remote-control operation—of all functions of the drill, rotation motor, feed motor and centralizer.

Adjustable feed mounting—gives proper thrust when drilling, maximum speed when retracting steel or inserting bolt.

Pneumatic centralizer remote-controlled—provides excellent support for accurate hole spotting.

Protective roof bolt wrench—guards against hammer impact on the roof bolt if hammer is accidentally turned on during the nut-running cycle.

EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

GARDNER - DENVER

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PRODUCTION EQUIPMENT preview

FOR DATA ON ANY ITEM IN THIS SECTION PLEASE WRITE MANUFACTURER DIRECT

Personnel Carrier Speeds to 20 Miles an Hour

A new personnel carrier for underground mining has been developed by the Getman Brothers.

The new carrier has an overall height of 45 inches; an overall width of 77 inches, and overall length of 17 feet 8 inches. The wheelbase is 98 inches. It has four wheel drive, four wheel steering for good maneuverability, and is equipped with four wheel hydraulic brakes. With speeds to 20 miles an hour, it has a carrying capacity up to 5,000 pounds. Write: **Maurice Feldman, Getman Brothers, Dept. MW, 551 Fifth Avenue, New York 17, New York.**

New Tractor Loader Carries Over Five Tons

Allis-Chalmers has expanded its line of tractor loaders with the introduction of the new TL-30. This four-wheel drive unit features a 10,500 pound carrying capacity, and a maximum lifting capacity of 25,000 pounds.

It is powered by an Allis-Chalmers "11000" Diesel engine with a rating of 184 horsepower at 2,200 rpm. It has a dumping clearance of over 10 feet, and six buckets are available ranging from two and a half to six cubic yards. Write: **Reuben Smith, Dept. MW, Allis-Chalmers Manufacturing Company, Milwaukee 1, Wisconsin.**

New Belt Construction

A new line of industrial conveyor belts, employing a rubber impregnated multiwoven carcass, has been introduced by H. K. Porter Company, Incorporated.

The new construction offers considerable savings because of superior resistance to ripping, gourging and tearing as well as excellent fastener holding ability.

Belts will be available on special order in width from 18 to 42 inches. Save working stress with fasteners is 210 pounds per inch of width. Write: **H. K. Porter Company, Inc., Thermoid Division, Dept. MW, Porter Building, Pittsburgh 19, Pennsylvania.**

Multiple Use Diesel Tractor

All wheel drive—all wheel steer Diesel tractors made by the M.R.S. Manufacturing Company offer economical power and maximum mechanical dependability for the mining and construction industries.

Equipped with either 123, 175 or 280 hp Cummins Diesel engines, these rugged units are adaptable for a variety of uses. Major accessory equipment includes 48 cubic yard struck capacity scraper unit, front end loader, bulldozer blades, and backhoe shovel. For information and details write: **M.R.S. Manufacturing Company, Dept MW, Flora, Mississippi.**

Hydraulic Reduction Crusher

An all new, completely hydraulic reduction crusher for secondary and tertiary operations has been introduced to the mining and quarrying industries by Kennedy Van Saun. It has a lower feed opening and requires less head room; the main shaft is top-supported by multiple hydraulic cylinders; the crusher setting is automatically held in the set position by a new control device; varying setting is a simple, one-hand operation; crusher automatically rejects tramp iron without damage and returns at once to correct setting. Write: **Kennedy-Van Saun Manufacturing & Engineering Corporation, Dept. MW, 405 Park Avenue, New York 22, New York.**

New Dry-Type Air Filter

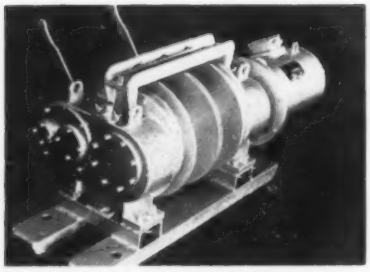
A new dry-type air Filtrator to replace side-outlet oil bath air cleaners has been developed by Harco Manufacturing Company.

The Filtrator features a semi-permanent element of urethane foam, and is designed with a pre-cleaner that traps more than 90 percent of engine-damaging material. The foam tube element is coated with oil to ensure entrapment of microscopic as well as large particles of dust. The controlled porosity of urethane foam not only allows a freer passage of air to the engine but will trap and hold more dirt than other media because it provides true depth filtration. Write: **Harco Manufacturing Company, Dept. MW, 1019 S.W. 10, Portland 5, Oregon.**

Stronger Alloys for Tools

New and stronger alloys have been incorporated by Spang and Company into its long-established lines of cable system tools for the water, gas, mining and petroleum drilling industry.

Tools made of these special steels will be marketed under the name of Spangaloy. Drilling jars made of this material offer two to three times the normal service life of earlier-made jars. Service life on stem boxes has been increased up to five times. Write: **Spang and Company, Dept. MW, Butler, Pennsylvania.**



Steel Disc Clutch Slusher

A new lightweight slusher, developed to meet the rugged standards of South African mining, is now available for use in the United States and Canada.

The Pillman slusher, featuring a multiple steel disc clutch, eliminates the use of external brake and clutch bands. Priced approximately ⅓ less than competitive models, the unit additionally features lower weight and higher rope pull per given horsepower when compared with other slushers. All welded construction, case hardened gears, no external moving parts, make this practically a maintenance free unit. Greasing is not required. Everything is sealed in oil, with the oil being changed once each year in two gearboxes.

Recent tests of 100 Pillman slushers in African mines indicate an average maintenance cost of $1.68, per year. The new, all-steel multiple disc clutch eliminates wasted horsepower through the elimination of conventional clutch and brake bands. Slushers are available in either double or triple drum models in sizes from 10 hp to 100 hp. Air or electric motors are available for 10 hp units. Larger sizes are electric. Write: **International Machinery Company, Dept. MW, 1022 East 12th Street, Oakland, California.**

New Equipment Manufacturer

A new company has been formed in Philadelphia, Pennsylvania, to manufacture and market materials classification and conveying equipment that incorporates unique and revolutionary design principles.

COMCO Corporation equipment includes a system of vibratory screens and conveyors that transmit no vibration to their foundation. They also manufacture a line of hydraulic classifiers and dewatering equipment that features precision, economy, and efficiency in the separation of particles in sizes from six millimeters to three microns. Write: **COMCO Corporation, Dept. MW, 5421 Lancaster Avenue, Philadelphia 31, Pennsylvania.**

TECHNICAL BROCHURE contains complete technical information about thorium, yttrium chemicals, metals and alloys of the rare earth group of elements. Write: **R. E. Levitan, Vitro Chemical Company, Dept. MW, 342 Madison Avenue, New York 17, New York.**

EQUIPMENT LEASING: A new illustrated brochure presents for the first time the complete facts about the leasing of new and used equipment. The brochure explains how any type or amount of equipment can be obtained on lease. Write: **United States Leasing Corporation, Dept. MW, 580 California Street, San Francisco 4, California.**

BELTING, HOSE, molded products, rubber specialties and hundreds of other products in the industrial rubber line are covered in the new 60-page catalog. Write: **Cincinnati Rubber Manufacturing Co., Advertising Department MW, 4900 Franklin Avenue (Norwood), Cincinnati 12, Ohio.**

LIVE BIN FEEDER: The development, construction details and features of a new feeder for metering all dry materials is described in a four-page illustrated technical bulletin. Write: **Vibra Screw Feeders, Inc., Dept. MW, 156 Huron Avenue, Clifton, New Jersey.**

FREE BOOKLET: "You Get More Profitable Production with Eimco" is the title of a new 12-page booklet just released which includes some direct comparisons between the Eimco line and competitive makes. Write: **EIMCO, Dept. MW, P. O. Box 300, Salt Lake City 10, Utah.**

TRUCK CRANE, said to be the world's largest, is described in a 12-page technical portfolio. Charts, cutaway photos, and drawings are included as well as operating specifications. Write: **Harnischfeger Corporation, Construction and Mining Division, Dept. MW, 4445 W. National Avenue, Milwaukee 46, Wisconsin.**

DRYERS, COOLERS, and heaters are the subject of a new, completely revised catalog just published by the Hardinge Company. The 24-page catalog on Ruggles-Coles equipment includes new material on fundamentals of drying, selection of proper drying equipment, and drying economics. Write: **W. H. Shank, Handinge Company, Dept. MW, York, Pennsylvania.**

LIFT TRUCKS in the 2,000 to 10,000 pound capacity ranges are described in a new 16-page catalog—BU-660—now available from **Allis-Chalmers Manufacturing Company, Dept. MW, Milwaukee, Wisconsin.**

LAND CRUISER is a versatile, rugged vehicle with four-wheel drive, 135 hp six cylinder engine, that can take seven passengers or a big payload of equipment. For details and further information on this latest vehicle to smash operating costs, write: **Toyota Motor Distributors, Inc., Dept. MW, 8701 Beverly Blvd., Los Angeles 48, California.**

CONTROL SYSTEM for conveyor belt feeding, blending, and proportioning is detailed in Bulletin 57A by the Industrial Physics and Electronics Company. CON–O–WEIGH is a highly accurate continuous belt scale for weighing free-flowing bulk materials. Write: **Industrial Physics and Electronics Company, Dept. MW, 470 So. 10th East, Salt Lake City, Utah.**

FOUR-WHEEL drive loaders are discussed in a new 16-page, full color, catalog. Write: **J. I. Case Company, Dept. MW, Racine, Wisconsin.**

ROD MILLS are available for either wet or dry grinding, and arranged for trunnion overflow or peripheral discharge. Catalog No. 25-C-O gives details on these mills that range in size from 2 to 13 feet. Write: **Hardinge Company, Inc., Dept. MW, 240 Arch Street, York, Pennsylvania.**

PINCH VALVES are the subject of Catalog No. 609 describing automated valve systems that control circuitry for any operating requirements. Write: **Mine and Smelter Supply Co., Dept. MW, 3800 Race Street, Denver, Colorado.**

"NORDBERG MACHINERY for the World's Major Industries" is the title of a new brochure which describes the wide variety of Nordberg products in a handy, 24-page booklet recently published. Write: **G. R. Wenzel, Nordberg Manufacturing Company, Dept. MW, Milwaukee, Wisconsin.**

DIAMOND TOOL Research Company, Inc. has now made available photographs, specifications, and pricing information for its standard line of Diamond Masonry Bits in the new comprehensive Catalog MB-61. Write: **Diamond Tool Research Company, Inc., Dept. MW, 380 Second Avenue, New York 10, New York.**

ELECTRIC SLUSHERS that range from 30 to 90 horsepower and easily handle heavy scrapers are made by Sala Maskinfabriks AB of Sweden. Details on these efficient two and three drum slushers are given in catalog 104. Write: **Sala Maskinfabriks AB, Dept. MW, Sala, Sweden** or **Machinery Center, Dept. MW, 1201 So. 6th West, Salt Lake City 10, Utah.**

Booklet Gives Answers to Unique Hauling Problems

An interesting 12-page booklet now offered by Athey Products Corporation, manufacturer of heavy-duty hauling and loading equipment, provides practical answers to unique hauling problems, particularly for jobs that cannot be handled by conventional wheeled vehicles.

The booklet, "Athey Forged-Traks," tells how this equipment provides hauling capability for many industries. It shows how it can operate wherever track-type tractors can work; in construction work, mining operations, exploration projects, and other fields. Write: **Athey Products Corporation, Dept. MW, 5631 West 65th Street, Chicago 38, Illinois.**

IGNORES EVERY OBSTACLE/SLASHES OPERATING COSTS

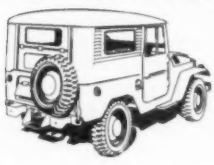
Land Cruiser has the power to climb steep 54% grades and plow through marsh or sand because it's powered by a mighty 135 HP 6-cylinder engine.

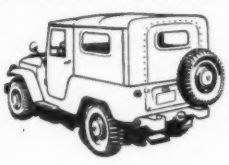
Land Cruiser has the room to take 7 passengers or a big payload of equipment because its hardtop or soft top bodies are 12½ ft. long, 5½ ft. wide.

Land Cruiser has the economy to slash your transportation costs. Initially, a Land Cruiser costs no more than any comparably equipped competitive 4-wheel drive vehicle of half the horsepower! From there on, you save on every trip because the Toyota Land Cruiser gets up to 28 MPG of gas from its highly efficient Toyota engine. You spend less time and money on maintenance because the Land Cruiser is more rugged, more durable, more **vehicle** than any of the others. And when it comes to regular servicing, you save again because every part of the Land Cruiser which needs periodic inspection is more accessible.

Drive a Toyota LAND CRUISER

at your nearest Toyota dealer and see for yourself.





For name of nearest dealer and further information, mail this coupon to TOYOTA MOTOR DISTRIBUTORS, INC. (Dept. I-8) 8701 Beverly Blvd., Los Angeles 48, Calif.

Send me more facts on the Land Cruiser and name of my nearest dealer.

Name_____

Address_____

City_____ State_____

New Safety Raise Block

The Safety Raise Block is an entirely new product developed for underground mining. It has practical application in raise driving and general utility work, being designed to reduce the hazards encountered in such activity.

The blocksides are extended well beyond the outside of the sheave and afford minimum space for entry of the wire rope, thus making an assembly offering maximum protection against the hazard of the worker's hand to be accidentally pulled into the sheave. Write: **Paul E. Keeney Company, 1125 S.E. Grand Avenue, Portland 14, Oregon.**

Portable Mechanical Gold Pan

A portable mechanical gold pan that takes the hard work out of testing and panning, and weighs only 95 pounds has been introduced by H & C Machinery Company of Houston, Texas.

The machine is primarily a shaker box with a water pump providing a sprinkler system so that no material escapes from being washed. Gold and other high gravity minerals sink immediately to the bottom and follow the contour to the rear of the box where they are held until released by a clean-out plug, at random. One shovel full of sand-gravel takes less than 5 seconds to process.

Anyone can operate the machine which runs for many hours on 1 gallon of gasoline. Write: **J. W. R. Henderson, Dept. MW, 6710 Chetwood, Houston 36, Texas.**

SHEAVE BLOCKS built for hard service are the new "F" series blocks which meet the need of mining men for rugged, dependable service. Bulletin No. 305 contains complete information. Write: **Alloy Steel & Metals Co., Dept. MW, P. O. Box 58323 Vernon Station, Los Angeles 58, California.**

PERCUSSION BITS for all types of rock drilling, quarrying, and open pit mining are covered in a new catalog. Charts contain data on each bit to help you choose the right bit for your equipment. Write: **Vascoloy-Ramet Corporation, Dept. MW, Waukegan, Illinois.**

BELT CLEANING that is automatic speeds cleanup time in quarries, mines and plants with a new system. A 200-foot conveyor belt operating at an average speed of 20 fpm, can be cleaned in 10 minutes. Write: **Sellers Injector Corporation, Dept. MW, 1600 Hamilton Street, Philadelphia 30, Pennsylvania.**

ARC WELDING products are detailed in Bulletin 7000.7 entitled "Welddirectory of Arc Welding Electrodes, Equipment, and Supplies." Write: **J. J. Revelt, Lincoln Electric Company, Dept. MW, Cleveland 17, Ohio.**

VENTI-BREATHER, a simple and economical oral resuscitator that overcomes mouth to mouth contact in rescue breathing, is illustrated and described in new literature. Write: **Mine Safety Appliances Company, Dept. MW, 201 North Braddock Avenue, Pittsburgh 8, Pennsylvania.**

MOVABLE JAW: A new brochure is available giving details about the Columbia 18-inch by 36-inch Cedar Rapids Twin Movable Jaw made from Armor-Tough manganese steel. This free bulletin gives weight, tooth depth, overall thickness, drawing number and other useful information. Write: **Columbia Steel Casting Company, Inc., Dept. MW, 933 N.W. Johnson, Portland 9, Oregon.**

BUCKET ELEVATOR systems for bulk handling of ores, gravel, sand, slag, and stone, are described in a new 84-page manual that illustrates a wide selection of types: centrifugal discharge, continuous bucket, gravity discharge elevator-conveyors, and pivoted-bucket carriers. Write: **H. A. Bernet, Jr., Webster Manufacturing, Inc., Dept. MW, Tiffin, Ohio.**

PACKAGED WHEEL assemblies for mine cars up to 25 tons in capacity can be used on custom-designed cars or cars built in the mine shop. Write: **Irwin-Sensenich Corporation, Dept. MW, Irwin, Pennsylvania.**

EASY SELECTION of Duty Master motors is described in full color Bulletin B-2515 which shows the complete line of new a.c. motors from 1 to 2,000 hp. Write: **Reliance Electric & Engineering Company, Dept. MW, 24701 Euclid Avenue, Cleveland 17, Ohio.**

FEED CONTROL through automatic blending of several different bulk materials into an integrated batching system offers precise control over total and individual product feed. Write: **Merrick Scale Manufacturing Co., Dept. MW, 180 Autumn Street, Passaic, New Jersey.**

BUILD-UP AND HARDFACING catalog carries product features, ordering information, and prices on a complete line of hardfacing and manganese steel build-up material. Write: **American Manganese Steel Division, Dept. MW, (A), 389 East 14th Street, Chicago Heights, Illinois.**

COLOR CODED EXPLOSIVES help eliminate confusion in choosing proper grade of explosives for hole charging operations reports Trojan Powder Company. Cartridges bear a distinctive color to remove human error. For details write: **G. L. Griffith, Jr., Trojan Powder Company, Dept. MW, 17 N. 7th Street, Allentown, Pennsylvania.**

NEW CONDITIONER adds liquids to solids and offers precise control over feed rates. Fields of use include application of binders to solids for pelletizing; surface treatment of solids; pre-wetting of ore for fatty acid flotation; reagent mixing; and fust control problems. Information on new Verticone is available from Johnson-March bulletin No. 5002-3. Write: **Wm. B. Aarons, Johnson-March Corporation, Dept. MW, 3018 Market Street, Philadelphia 4, Pennsylvania.**

PAYDOZER line of rubber-tired pusher-dozers has a new addition with the Model D-500 that weighs in excess of 100,000 pounds. This powerful unit has full hydraulic-articulated steering which provides exceptional maneuverability, and a turning radius of less than 25 feet. Write: **M. L. Crawford, The Frank G. Hough Company, Dept. MW, Libertyville, Illinois.**

CLAMSHELL MUCKER and bucket dump for small shafts saves on manpower and investment with efficient operation. Write: **The Coeur d'Alenes Company, Dept. MW, Box 969, Wallace, Idaho.**

PUMPS with capacities from 1 to 90 gallons per minute are John Bean's new 7000 series Triplex units. They offer a 50 percent increase in gallon-per-minute displacement at no extra cost. For a free catalog write: **John Bean, Food Machinery and Chemical Corporation, Dept. MW-6, San Jose, California.**

CONCRETE PLACEMENT: For low cost concrete gunning in mines and tunnels the Ridley C-3UG machine is a fully integrated, compact gunning rig for speedy, safe, and economical underground concrete placement. For information on how to cut costs in this field write: **Ridley and Company, Inc., Dept. MW, 2217 Pontius Avenue, Los Angeles 64, California.**

Proof from Jones & Laughlin!

Ni-Hard liners keep their contour after grinding better than 2 million tons of ore

Here's photographic proof from the Benson Mine, New York Ore Division of Jones & Laughlin Steel Corporation in upstate New York.

Ni-Hard liners keep their contour — resist abrasion — provide a slow, uniform wear rate — are good to the last ¼ inch.

You could never tell by looking at them, but these Ni-Hard* nickel-chromium-iron alloy shell liners have been grinding iron ore *for more than 2 years.* With better than 2 million tons of ore behind them, they've still got plenty of tonnage left in them!

Used in J&L's ball mills and rod mills —at the feed end as well as the discharge end—these Ni-Hard liners are delivering *superior abrasion and wear resistance.* They're saving many thousands of hours of downtime, many thousands of dollars in repair and replacement.

Try a set of Ni-Hard liners and see for yourself how the abrasion and wear resistance of Ni-Hard can increase *your* tonnage, can lower *your* costs.

Our detailed 58-page booklet, "Engineering Properties and Applications of Ni-Hard" suggests many ways to put this versatile and long-lasting material to work profitably. Say the word and we'll be glad to send you a copy.

*Registered trademark

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street INCO New York 5, N. Y.

NI-HARD®

NICKEL MAKES CASTINGS PERFORM BETTER LONGER

Metal & Mineral Prices

U. S. A.

July 24, 1961

METALS

COPPER: Electrolytic. Delivered F.o.b. cars, Valley basis (pound) ... 31.00¢
Lake. Delivered, destinations, USA ... 31.00¢
Foreign. Delivered, destinations, USA ... 31.00¢
LEAD: Common Grade. New York (Per pound) ... 11.00¢
Tri-State Concentrate, 80% lead, per ton ... $125.16
ZINC: Prime Western: F.o.b. E. St. Louis (Per pound) ... 11.50¢
Prime Western: Delivered New York ... 12.00¢
Tri-State Concentrate, 60% zinc per ton ... $68.00
ALUMINUM: Primary 50 Pound Ingots (99.5% plus) (Per pound) ... 26.00¢
ANTIMONY: Lone Star Brand. F.o.b. Laredo, in bulk (Per pound) ... 32.50¢
BISMUTH: (In ton lots) price per pound ... $2.25
CADMIUM: Sticks and bars. 1 to 5 ton lots Price per pound ... $1.60
COBALT: 97-99%, keg of 500 pounds (Price per pound) ... $1.50
COLUMBIUM: Ingot Nominal, per pound $36.00-$55.00
GERMANIUM: dioxide, high purity, gram ... 16.75-21.75¢
LITHIUM: 98% (per pound) ... $9.00-$12.00
MAGNESIUM: Ingots (99.8%) F.o.b. Velasco, Texas per pound ... 36.00¢
MERCURY: Flasks. Small lots, New York ... $193.00-$197.00
NICKEL: "F" Ingots (5 pounds) F.o.b. Port Colbourne, Ontario ... 82.75¢
PLUTONIUM: To July 1, 1962 AEC will pay $30.00 to $40.00 per gram depending on plutonium 240 content. July 1, 1962 to June 30, 1963, per gram ... $30.00
SELENIUM: 99.5% per pound ... $6.50-$7.00
TELLURIUM: Common grade, Per pound ... $5.25
THORIUM: per kilogram ... $43.00
TIN: Grade A Brands. New York (Per Pound) Prompt delivery ... 115.625¢
TITANIUM: 99.3% + Grade A-1 Sponge (Per pound) ... $1.50-$1.60
URANIUM: Normal, Per Pound ... $24.00
VANADIUM: 90% Grade ... $3.45
GOLD: United States Treasury Price ... $35.00 per ounce
London ... $35.16 per ounce
SILVER: Newly mined domestic. U.S. Treasury price per ounce ... 90.5¢
Foreign Handy Harmon ... 91⅜¢
PLATINUM: Per ounce ... $82.00-$85.00
ZIRCONIUM: Sponge, Per pound, Reactor Grade ... $5.00

ORES AND CONCENTRATES

BERYLLIUM ORE: 10 to 12% BeO. F.o.b. mine, Colorado $46.00 per unit
Small lot purchases at Custer, S. D., Spruce Pine, N. C., and Franklin, N. H. Visual inspection at $400.00 per short ton or by assaying at 8.0 to 8.9% BeO, $40 per unit; 9.0 to 9.9%, $45; over 10.0%, $48.00.
CHROME ORE: F.o.b. railroad cars eastern seaports. Dry long tons.
African (Rhodesian). 48% Cr_2O_3. 3 to 1 ratio ... $35.00-$36.00
African (Transvaal). 48% Cr_2O_3. No ratio ... $26.00-$28.00
Turkish, 48% Cr^2O^3. 3 to 1 chrome-iron ratio Nominal $36.00-$37.00
COLUMBIUM-TANTALUM ORE: Per Pound Pentoxide, Nominal ... $1.10
IRON ORE: Lake Superior. Per gross ton Lower Lake Ports
Mesabi, Non Bessemer, 51.5% Fe ... $11.45
Mesabi, Bessemer, 51.5% Fe ... $11.60
Old Range Non Bessemer ... $11.70
Old Range Bessemer ... $11.85
Lump: Plus ½-inch ... $12.85
Fines: Minus ½-inch ... $10.72
Swedish, Atlantic Ports, 60 to 68% Fe Contracts, Per Unit ... 24.00-25.00¢
Brazilian, Atlantic Port, 68 to 90%, Long ton unit ... 22.00-22.50¢
Venezuelan, Orinoco No. 1, 58% Fe, f.o.b. Puerto Ordaz ... $8.95
MANGANESE ORE: Metallurgical grade. 48 to 50% Mn Long ton unit ... $0.90-$0.95
Metallurgical grade. 46 to 48% Mn. Long ton unit ... $0.85-$0.90
Metallurgical grade. 44 to 45% Mn. Long ton unit ... $0.85-$0.90
Domestic U.S. Government. GSA Basis $2.30 per unit for 48% Mn.
MOLYBDENITE CONCENTRATE: 90% MoS_2 F.o.b. Climax, Colorado. Per pound Mo, plus container cost ... $1.40
TUNGSTEN CONCENTRATE: Domestic. 60% WO_3 Per short ton unit ... Nominal $23.50
Foreign: 65% WO_3 Per short ton unit (Scheelite) ... Nominal $17.00
Foreign: South American, Spanish, Portuguese ... Nominal $16.50
URANIUM ORE. F.o.b. purchase depot or company mill in accordance with AEC schedules and company buying contracts. Basic price is $1.50 per pound of U_3O_8 in ore assaying 0.10 percent. For each additional 0.01 add 20¢. Subject to development allowance, premiums, penalties where applicable.

NON-METALLIC MINERALS

BARITE: Oil well drilling. Minimum 4.25 specific gravity, per short ton ... $16.00
BENTONITE: Minus-200mesh. F.o.b. Wyoming. Per ton, carload lots $12.50
Oil Well grade. Packed in 100 pound paper bags ... $14.00
BORON: technical grade ... F.o.b. Boron California. Per ton ... $47.50
FLUORSPAR: Metallurgical grade. 72.5% effective CaF_2 content per short ton F.o.b. Illinois-Kentucky mines ... $37.00-$41.00
Mexican. 70% F.o.b. border, Duty paid ... $27.00-$28.00
Acid Grade. 97% CaF_2 Bulk, F.o.b. mine ... $45.00-$49.00
PERLITE: Crude: F.o.b. mine per short ton ... $3.00 to $5.00
Plaster grades. Crushed and sized. F.o.b. plants ... $7.00 to $9.00
SULPHUR: Long ton, f.o.b. cars, mines ... $22.50-$23.50
F.o.b. vessels Gulf Ports ... $24.00-$25.00

London

July 24, 1961

		Per Long Ton	USA Equivalent	cents per pound
COPPER:	Electrolytic, spot	£230	15s 0d	28.84¢
LEAD:	Refined 99%	£ 65	2s 6d	8.14¢
ZINC:	Virgin 98%	£ 77	17s 6d	9.73¢
ALUMINUM:	Ingot, 99.5%	£186	0s 0d	23.25¢
ANTIMONY:	Regulus, 99.6%	£230	0s 0d	28.75¢
TIN:	Standard, 99.75%	£914	0s 0d	114.25¢
TUNGSTEN:	Long ton unit	£ 0	130s 0d	$18.26

*With Sterling Pound at $ 2.80

Quotations on metals and certain ores through the courtesy of *American Metal Market, New York, New York*

NEWSMAKERS in world mining


T. O. EVANS


M. A. KURYLA


G. S. MARWAHA


C. M. ROMANOWITZ


N. C. WILLIAMS


R. W. YERBURY

The Ambrosia Lake uranium mining industry honored **Thomas O. Evans,** chief mining engineer for Haystack Mountain Development Company and "dean" of Southwest uranium mining with a dinner late in June after the close of Haystack's operations at Grants, New Mexico.

Michael A. Kuryla, has been named manager of the Lima, Peru, division of Cerro de Pasco Corporation. Mr. Kuryla was former deputy manager of the Lima division and has been associated with mining in Utah for many years. He succeeds **Julian D. Smith,** who has resigned for reasons of health.

Dr. Martin Schwellnus, chief geologist for the Messina Transvaal Development Company, Ltd., of the Republic of South Africa, is touring lead and iron mines during an extended visit to the United States and Canada.

Pavel Zima, formerly with the consulting firm of Behre Dolbear & Company, New York, New York, has joined Pittsburgh Pacific Company, Hibbing, Minnesota, as mining engineer.

A. H. Shoemaker has resigned his position as Vice President and general manager of Homestake Mining Company, San Francisco, California, to become the company's consulting engineer.

Roland D. Parks, Massachusetts Institute of Technology, Cambridge, Massachusetts, professor of geology and geophysics will serve as Fulbright Lecturer in mining engineering at the University of Assiut, Assiut, Egypt, United Arab Republic, during the 1961–1962 academic year. He plans to visit some of the European mining centers enroute to Cairo, Egypt.

Three engineers from the Dowa Mining Company, Tokyo, Japan, have been on a five-week tour of United States mining areas. Studying mining methods and equipment at St. Joseph Lead Company's Missouri operations were **Yoshiteru Suzuki,** director and general manager of the Hanaoka mine; **Tsuneo Moriyoshi,** chief of the mining section Akagane mine; and **Tomonobu Kubota,** chief of the milling section of the Kosaka mine.

Mark Lintz, Prescott, Arizona, mining and metallurgical engineer, is in Coahuila, Mexico, where he is doing exploration work on fluorspar deposits.

Donald F. Anderson has been promoted to chief metallurgist at the Riverton, Wyoming mill of the Lucky Mc Uranium Division of Utah Construction and Mining Co. He had been metallurgist at the mill.

G. S. Marwaha, specialist in mine safety, has been appointed president of the Central Coal Mines Rescue Stations Committee of the Government of India. Mr. Marwaha, who is a Pickering Medallist of the Indian School of Mines, is a former regional inspector of mines.

Charles M. Romanowitz, internationally-known dredging expert, has opened a consulting office at 2034 Santa Clara Avenue, Alameda, California. He is immediately available for consultations in dredge application and operation, both bucket-line and hydraulic. He is best known for his 50 years of connected bucket-line dredging experience, but has equal experience with hydraulic dredges. From 1920 through 1958 he was responsible for recommending and installing all dredges for Yuba Manufacturing Co. From 1912 to 1920 he held a similar position for the Natomas Co. For the last three and one-half years he has been with the Ellicott Machine Corp. with headquarters in San Francisco, California, on a full-time basis but is now being retained as consulting engineer.

G. Christian Amstutz, of the geological department, School of Mines and Metallurgy, Rolla, Missouri, is currently serving with the United States Government Tin Mission in Bolivia. His address is Hotel Crillon, La Paz, Bolivia. Mr. Amstutz is author of MINING WORLD'S zinc survey, published in the 1961 Annual Catalog, Survey & Directory Number.

Jim Ludwig, former general mine foreman, has been named assistant mine superintendent at Climax Molybdenum Company's Climax, Colorado operations. He succeeds **Chuck Cleeves,** who has been promoted to mine superintendent.

Alexander B. Kane has been appointed superintendent of the Anaconda Company's slag treating plant at East Helena, Montana. Mr. Kane, who moves up from assistant superintendent, is replacing **Robert L. Thompson,** who has retired. Succeeding Mr. Kane as assistant superintendent is **Howard J. Bardwell,** former assistant lead plant superintendent for International Smelting & Refining Company, an Anaconda subsidiary, at Tooele, Utah.

Victor M. Morales, formerly associated with Cia. Minera Nacional in Pichachos, Mexico, is now general mine foreman of the San Martin unit, owned by Cia. Minera ASARCO, Sombrerete, Mexico.

C. T. Penney, formerly associated with Copper Rand Mines, Chibougamau, Canada, is now employed by Lindsay Explorations Ltd., Port Arthur, Ontario, Canada.

Dr. Norman C. Williams, professor of geology at the University of Utah, has resigned to assume full time duties as vice president and chief geologist of Beryllium Resources, Inc., of Salt Lake City, Utah.

Richard W. Yerbury, design engineer, has been named to the product development department of Machinery Center, Inc., Salt Lake City, Utah. Mr. Yerbury brings with him a background of experience in designing and supervising the building of mining equipment.

C. H. E. Stewart, consulting mining engineer, has moved to new offices at Suite 416–417, 25 Adelaide St. West, Toronto 1, Canada.

Leonard B. Lively of Melrose, Montana has been elected president of the Southwestern Montana Mining Association. He operates the Lively Mining Company.

Six mining officials from Israel have been inspecting United States mining operations under the sponsorship of the United States International Cooperation Administration. **Shimeon Ishai,** deputy managing director of Israel mining industries at Ramat Gan; **Meri Gelbart,** assistant director-general of the Ministry of Development, Holon; **Pinhas Mozes,** equipment engineer for Israel mining industries at Tel Aviv; **Harry Sandler,** production manager for copper mines at Eilat; **Mordekhai Segelstein,** phosphate mines supervisor, and **Yehuda Ziv,** production manager, both of Negev Phosphates Ltd., Tel Aviv, visited smelters in Texas, and copper and phosphate mines in the Western states.

Manuel Llosa has been appointed deputy manager of the Lima, Peru, division of Cerro de Pasco Corporation. Senor Llosa, who served with Cerro de Pasco from 1945 to 1947 and rejoined the company in 1952, was formerly technical advisor of the Lima division.

Lawrence J. Ingvalson, general superintendent of the Great Falls, Montana, reduction department of the Anaconda Company, has been appointed manager, succeeding **Floyd S. "Dutch" Weimer,** who has retired. **Leonard C. Powell,** assistant general superintendent, assumes Mr. Ingvalson's position as general superintendent.

Frank Windolph, assistant general superintendent at Climax Molybdenum Company's Climax, Colorado operations, was appointed general superintendent. He has been succeeded by **Bill Distler,** former mine superintendent.

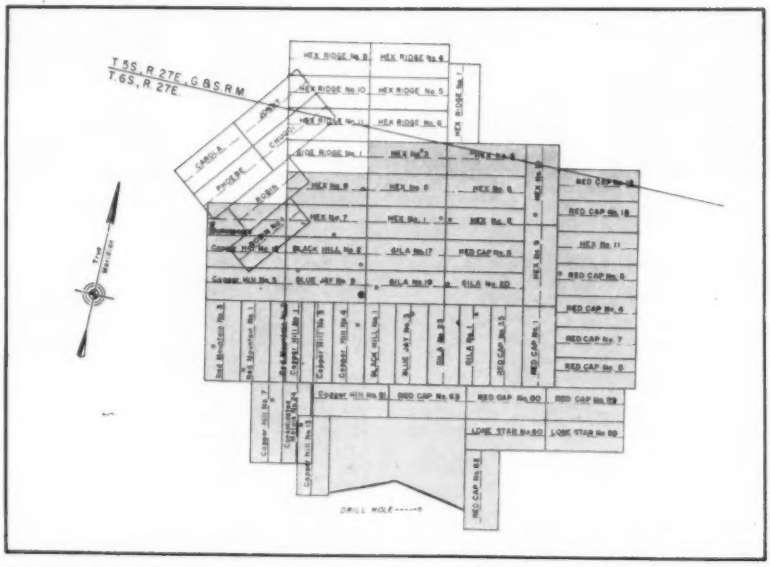
WHAT'S GOING ON in mining

Kennecott Patents 41 Safford Claims

Final patent certificates are being issued by the Bureau of Land Management to Kennecott Copper Corporation for 41 mining claims in the Lone Star Mining District, near Safford, Arizona.

The greatest part of the patented area is located in T. 6 S., R. 27 E., Gila and Salt River Meridian as shown on the adjoining diagram. The shaded area represents patents. While the claim boundaries for mineral survey No. 4455 are not shown they are known to lie in the southern center of the group and are included in shaded section. Patented area totals 771.513 acres. Details of the five certificates are as folows:

Patent Number	*Mineral Survey*	*Number Of Claims*	*Total Acres*
AR 026028	4453	3	55.957
AR 026029	4454	1	20.288
AR 026030	4457	30	553.313
AR 026031	4455	6	121.330
AR 026032	4475	1	20.625



The patent proceedings were handled for Kennecott by H. J. Vander Veer, consulting engineer of Salt Lake City, Utah. Vander Veer states that to the best of his knowledge this is one of the largest groups of mineral claims to be taken to patent in Arizona in recent years.

The patented claims are a portion of Kennecott's holdings in the Lone Star district where a major exploration project is in progress. Horizontal development workings are being driven from the bottom of the recently completed 800-foot shaft to permit bulk sampling of the ore body. Numerous engineering and metallurgical problems must be solved, Kennecott says, before the economic potential of the deposit if fully ascertained.

Kennecott purchased the Safford property in 1959, paying approximately $4,000,000 for a block of some 120 mining claims aggregating about 2,000 acres. The purchase followed an extensive drilling program started in 1956, which confirmed the existence of a large low-grade deposit.

Thorium as Nuclear Fuel—Its Advantages and Disadvantages

A relatively late start in series development of thorium as a nuclear fuel has been a disadvantage. "Thorium has many handicaps in its competition with uranium," reported U. M. Staebler, senior assistant director, Division of Reactor Development, United States Atomic Energy Commission at the Sixth Nuclear Congress in Rome, Italy.

Thorium does have certain advantages to offer, too, so it is still a definite contender, he added. "Its value can be known only after considerably more work has been done and, in particular, after experience has been obtained operating reactors and associated supply or servicing facilities."

Mr. Staebeler made the following observations on uranium versus thorium for nuclear fuel.

"Note for example that the average thorium content of the earth's crust is three to four times that of uranium; on the other hand, their geochemical properties and the manner in which deposits were formed in higher-than-normal concentrations indicate that uranium reserves and potential annual production rates would be several times those of thorium at current prices. In other words, the unit cost would have to go up appreciably before thorium would be equal in availability to uranium. Of course these are average situations of ore availability—obviously there are local situations in which thorium is much more plentiful and thus of much greater interest as a nuclear fuel.

"The fact that nature provided a starter in the form of U-235 in natural uranium is at least partially offset now by the relatively better nuclear properties of U-233 in comparison with Pu-239 for reactors operating primarily on thermal neutrons. This relative advantage of U-233 persists into the epithermal energy range. This nuclear advantage is in two forms—1. higher value of eta, thus more neutrons are produced per neutron absorbed which means, for comparable losses, more neutrons are available for conversion of new fuel, and 2. avoidance of the positive temperature coefficient associated with low level resonance in Pu-239. This latter effect is particularly important for reactors which are to operate at high temperatures."

Thorium hasn't been forgotten and a dedicated group works to find out how to better use thorium as a fuel. He pointed out that, "Work on thorium-based fuel materials is expanding, it must be recognized and emphasized that much less effort has been devoted to this cycle than to the materials involved in the uranium-based fuel cycle. Fortunately, many of the lessons learned in uranium development are either applicable or at least helpful in the development of thorium which, in fact, is a less complex material. Thus, hopefully, progress may proceed at a greater rate than the relative efforts would suggest."

Rare Metals Adds Carbonate Leach at Tuba City Uranium Mill

To save $3.00 per ton in milling cost for treating Orphan mine ore of Western Gold & Uranium, Inc., a new carbonate leaching circuit is scheduled to be added to Rare Metals Corporation's Tuba City, Arizona, mill. The new circuit and a sales contract for Western Gold's ore is subject to an award of a 1962 to 1966 production allocation to the Orphan and a sales contract between Rare Metals and the Atomic Energy Commission. Negotiations for both contracts should lead to agreement on both.

In 1960 Rare Metals milled 107,757 dry short tons of 0.27 percent U_3O_8 ore at Tuba City, which was the mill's maximum capacity, to yield concentrate at the allowable contract rate. About 7,000 tons per month of ore milled comes from the Orphan Mine.

Alaska

Bear Creek Mining Company (Kennecott Copper Corporation) is continuing its exploration and development program at its **Ruby Creek** copper deposit where diamond drilling has been carried on for the past several summers. An important deposit of fairly high grade copper has been developed, but transportation problems must be solved before large scale mining can be started. A large part of the work force is Eskimos from Kobuk and Shungnak.

Mt. Andrews Mining Company (Utah Construction and Mining Company) has a major exploration campaign underway in southern Alaska this season seeking iron and copper for export to Japan. Geological reconnaissance, mapping, and diamond drilling are underway.

A number of independent miners are operating their gold dredges this summer on Alaskan creeks. **N. B. Tweet & Sons** and the **Lucky Syndicate** are both dredging on the Kougarok; **Grant Nelson** has two dredges on Utica Creek; and **Steve Peterson** is digging near Council.

Lee Brothers are moving their gold dredging operation on the Solomon River to Cape and Buck Creeks where they expect to mine placer tin. However, no production is scheduled for this year. The brothers are continuing to recover placer gold by dredging on the Solomon River.

Arizona

A crew of 12 men is working at the **Golden Gem** mine of the **Cerbat Mining Company**, preparing the property for production. The upper portion of the 650-foot shaft is being repaired and the 300-foot level is being cleaned out so stoping can be resumed above this level. The 50-ton mill is being reconditioned and a larger ball mill, crusher, and additional flotation cells have been purchased. They are to be installed after the existing plant is started and are expected to increase the plant's capacity to 200 tons per day. Manager of the operation is Vic Howard, Kingman, Arizona; Floyd Brown is superintendent.

Thomas Bardon, president, **Shattuck Denn Mining Corporation**, has stated that test drilling at the **Iron King** mine near Mayer, Arizona, confirmed the continuation of the mineralized structure and indicated tonnage and grade of ore which should add many years to the operation of the mine. A separate underground exploration program is being carried on outside the present main ore structure and parallel to it. As a result, other mineralized horizons were discovered in which the indicated ore contains copper in considerably higher ratio to the other metals than has been normal for Iron King production. These horizons, which are accessible from existing workings, are being further explored. In 1960, the Iron King, one of the nation's leading lead and zinc mines, reported the production of 304,735 tons of ore which yielded 38,993,593 pounds of zinc, 11,368,051 pounds of lead, 470,918 pounds of copper, 24,263 ounces gold, and 796,809 ounces silver.

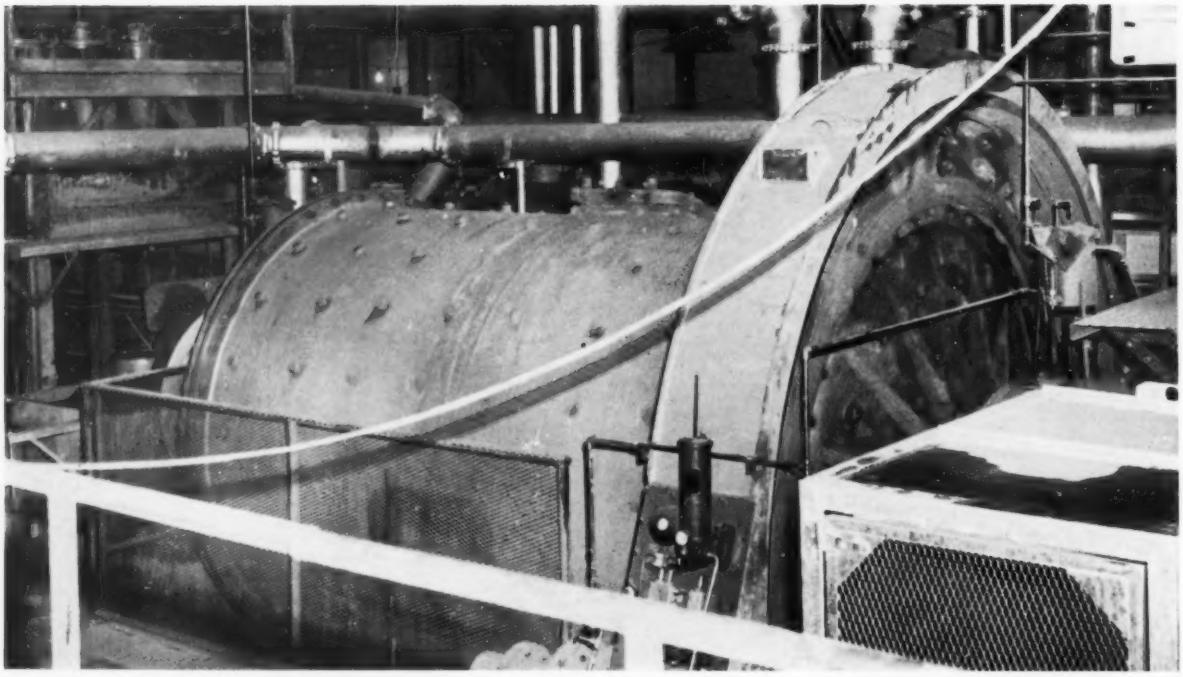
Intermountain Exploration Company has been drilling the molybdenum-copper deposit at the **Squaw Peak** mine at Camp Verde which it holds under a lease and option. Glen Thatcher of Tucson is the drilling contractor. Richard V. Wyman is Intermountain president with headquarters at St. George, Utah.

James V. Marino, Washington Camp, Arizona, has leased the **Bonanza, Illinois** and **Estella Louise** mines in the Duquesne district of Santa Cruz County, Arizona, from the owner, **Nash Mines**, Austin Texas. Since work was started the Bonanza workings have been dewatered and some repair work completed. At present a raise is being driven from the 235-foot level in an attempt to develop ore in that area. A crew of four men is employed.

Richard Himebaugh of Patagonia, Arizona, has the contract for an adit being driven into the mountain at the **Ten Grand** mine, owned by W. D. Roper, Patagonia, Arizona. The adit was in about 350 feet in late May and will be continued to a distance of 600 to 700 feet. Seven men are employed, with the work in progress on three shifts six days a week. Mine equipment includes two air compressors, one double-drum slusher and several mine cars. The Ten Grand is a

COMPANIES IN THE NEWS

Anaconda Selects Marcy Mills for its modernization program



One of three new 9′ x 14′ Marcy Ball Mills at Anaconda

Photo courtesy Mining World.

Anaconda Reduction Works, Anaconda, Montana, has an extensive modernization program to improve metallurgical results and reduce costs.

This program includes a regrind stage on rougher flotation concentrates and the company selected three 9′ x 14′ Marcy Ball Mills for the job.

Anaconda Has Purchased More Than 70 Marcy Mills

During the past 30 years Anaconda and its subsidiaries have purchased a total of more than 70 Marcy Ball and Rod Mills . . . evidence of the efficient and economical operation of Marcy Mills.

We want a chance to ask **YOU** for **YOUR** order . . . by having an opportunity to show you how **YOU** can improve metallurgy and reduce costs with Marcy Mills. We invite your inquiry by letter, wire or phone.

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group of 136 unpatented claims, 57 of which were located in 1959 and the other this year. It is a new copper development, about five miles southeast of Patagonia.

The Pozzolan Division of **Standard Gilsonite Company** is continuing regular production at the **Bonner** deposit north of Flagstaff, Arizona. Deliveries to the Glen Canyon Dam currently are at the rate of 65 loads (27 yards each) or about 1,750 tons per week. Additional grinding capacity is being installed in the plant to permit an increase in output and closer control of produce size. Darrell W. Sumner, Flagstaff, Arizona, is superintendent.

L. E. Town, Globe, Arizona, is operating the **LeTourneau** asbestos mill producing about a ton of carded acid-washed No. 1 and No. 2 grades of asbestos per day. The finished product is packed in cartons for shipment to the weaving trade for paper making. Four men are employed.

Exploration work is in progress at the **Montezuma** mine, a part of the **Baca Float Mineral Segregation,** in the Tyndall district of Santa Cruz County, Arizona. The mine is under lease and option to Larry Drake, Tucson, Arizona. At present, two inclined shafts are being sunk; one is an extension of an old 50-foot shaft, and a depth of 300 feet on a 50 to 55° incline is projected for both. Earlier exploration work completed included about 1,500 feet of diamond drilling, and several carloads of copper-silver ore have been shipped. Seven men are employed in the current work.

The **Solar Minerals, Inc.,** Twin Falls, Idaho, has taken over the **Copper Giant** mine in Hackberry district of Mohave County, Arizona, and is rehabilitating the workings. An economic study is being made to decide on what exploration and development program, if any, will be undertaken. Meanwhile, several carloads of dump ore have been shipped and others will follow. The **Copper Giant** is owned by Ray Van Marter, Kingman, Arizona, and until recently was under contract to **Ran Rex Oil and Mining Company.** Lynn Burr, who was in charge for Ran Rex, is superintendent for the new concern. The local office of Solar Minerals is in Kingman.

California

Build Two California Asbestos Mills; A Third Is Planned

California's first large asbestos mill is scheduled for completion and operation by the first of January 1962. It is the Coalinga mill of the Coalinga Asbestos Company, Inc. formed by Johns-Manville Corporation and Kern County Land Company. The new mill will treat open-pit ore to produce up to 25,000 annual tons of high quality "shorts" for use in cement, asphalt, and vinyl-asbestos products. L. D. Folsom Inc. and Remo Construction Company are building the mill under contract. Charles D. Borror has been appointed manager of the new company. He formerly was production engineer for the asbestos fiber division of Canadian Johns-Manville Co. Ltd. at Asbestos, Quebec. He has been employed for 33 years as an engineer and executive by that firm.

Construction of the 2,500-ton-per-day asbestos mill of Jefferson Lake Asbestos Corporation near Copperopolis started in June. Tellepsen Petrochem Constructors of Houston, Texas have the prime contract and have retained Kilborn Engineering Company of Toronto, Canada to assist with engineering design. Completion target is March 1962. Open pit mining will be carried out under contract with Wells Cargo, Inc. of Las Vegas, Nevada.

Hidden Splendor Mining Company has a substantial deposit of asbestos in the Coalinga district which probably can be mined by open pitting. The firm's market studies show that 12 percent of the United States' asbestos market is in California. Development of a mine and construction of a mill are under study.

The fourth major company interested in California asbestos is Union Carbide Nuclear Company which holds more than 100 claims in the New Idria-Coalinga area, but has announced no plans for commercial production.

Jalander Magnetometer To Be Loaned Free to Universities

The Jalander Electronic Magnetometer is now available to universities and colleges in the United States on a free loan basis, according to a recent announcement made by the Jordan International Company. The instrument will be loaned without charge to qualified mining and geological departments of recognized universities for short periods of time for demonstration of surveying procedures, field work, and classroom study. It is only necessary for the borrowing institution to pay the costs of shipping to and from San Francisco. The portable magnetometer has a range of from 10 to 250,000 gammas, with the added features of lightweight, open scale, and low power consumption. Because of the simplicity of operation, universities and colleges are certain to find the instrument of particular value for educational purposes. Further information on its availability may be obtained by writing to Jordan International Company, 444 Market Street, San Francisco 11, California.

The **Surcease Mining Company's** directors have voted to liquidate the company assets, dissolve the company, and retire from the mining business. The company held over 1,000 acres of mining property, mostly patented claims, in the Atolia mining district of San Bernardino County. The company was one of California's largest scheelite producers from these claims during World War II and the Korean War. The shutdown left developed tungsten in working faces and good prospects for a potential undeveloped ore zone in virgin territory. The company wil dispose of its camp, mining and milling equipment, and water system in the next few months. J. W. Hoefling of 2414 E Street, Sacramento, California is a director.

Income from gold bullion sales of placer gold recovered by the one remaining dredge of the **Natomas Company** in Sacramento County, California for the first three months of this year was $104,320. Similar period 1960 income was $116,168.

Continental Materials Corporation has secured a lease and option on the **Uncle Sam** gold mine in Shasta County, Cali-

fornia and plans an exploration program this summer. Continental operates uranium mines in Colorado, Utah, and Wyoming and has its mining headquarters in Grand Junction, Colorado.

Central

Miller-Adlick Company, fluorspar brokers from Cincinnati, made a purchase bid of $110,000 for the insolvent **Mackey-Humm Mining Company** at a public auction held recently in Elizabethtown, Illinois. Miller-Adlick, the largest creditor of the mining company, made the only bid at the auction, and reportedly plans to organize a company to operate the mine and mill.

The **Division of Resources and Development** of the State of Missouri has finally received the $20,000 appropriation allocated it for a steel mill survey to be made by the New York, New York engineering firm of **Ford, Bacon and Davis.** Funds had originally been held up by Governor John M. Dalton who wanted to investigate further the feasibility of the project to get a steel mill located in Missouri to process Missouri iron ore.

A cave-in occurred recently at **Minerva Oil Company's Crystal** flourspar mine northeast of Elizabethtown, Illinois. Although the cave-in started in a drift 110 feet underground, surface subsidence soon left a crater 35 feet deep by 100 feet across and broke a six-inch water line carrying water to the Crystal mill. This caused the mill to temporarily shut down. There were no injuries to men in the mine, and the flow of muck and debris was stopped by the quick erection of a concrete bulkhead in the drift. I. V. Robertson is superintendent of the Crystal operation.

American Zinc Company of Tennessee has purchased the mineral rights to two tracts of land near its **Mascot,** Tennessee, zinc mine. One 450-acre tract, belonging to Mrs. M. P. Woods, was bought for $57,565. A second tract containing 125 acres was bought for $12,858 from C. B. Thomas.

Tennessee Copper Company has recently put into operation a new Fluo-Solids roaster at Copperhill. The new plant will expand copper smelting facilities to take care of the expected increase in ore grade from the **Calloway** mine, which is just starting as an ore producer.

American Zinc, Lead and Smelting Company and **Granite City Steel Company** have been jointly prospecting for iron ore in Missouri with three diamond drills and one churn drill. The results of drilling have been encouraging, and substantial additional reserves have recently been indicated.

Copper Range Company's new southwest ore body, discovered in 1959, will be brought into full production in 1964. The ore body is about two miles southwest of the **White Pine** mine at White Pine, Michigan, and is described as being at least 50 percent higher grade. Although metallurgy will be different, the ore will be treated in the White Pine concentrator. The development shaft, begun in August 1960, is expected to reach the ore by October of this year. About six months will then be required to determine the amenability of the ore to concentration. During this period tests will also be made to gain necessary data for mine development, and once determined, a production shaft will be sunk. The southwest ore body lies on the down-side of the White Pine fault some 2,000 feet below the surface.

A **Germanium Information Center** has been organized at the **Midwest Research Institute,** Kansas City, Missouri, according to Dr. Buell Beadle, director of the chemistry division. Sponsored by several American mining companies as well as the **Union Miniere du Haut Katanga, Societe de la Vieille Montagne,** and **Tsumeb Corporation, Ltd.,** the new center will encourage and correlate germanium research, and seek new uses for the metal.

Colorado

Froth Flotation Technical Papers Announced For Denver

The 50th anniversary of froth flotation in the United States will be commemorated in Denver, Colorado on September 17th through the 20th. The AIME's Mineral Beneficiation Division will sponsor the meeting. Papers to be presented at the meeting are:

New and Future Uses for Flotation; Flotation of Micro-Organisms; Future Flotation Research; Froth Flotation of Ion-Exchange Resins and Its Application to Practice; Flotation Aids Cyanida-

tion of Pachuca Ores; and New Developments and the Future of Flotation in Italy.

Kinetics of Flotation; Measurement of Zeta Potentials by Radial Streaming Method; Influence of Radiation in Flotation; Hydrolytic and Ion Pair Adsorption Models for Collectors in Flotation; Refinements in Methods of Determining Flotation Rates; Flotation Machines.

Present Flotation Practice; Present Flotation Practice in the Coal Industry in Great Britain; Recent Developments in the Flotation of Oxidized Ores of Copper, Lead, and Zinc; Molybdenum Flotation; Phosphate Flotation; Flotation of Iron Ore.

Milling Circuits Design and Effects on Mining and Smelting; Flotation Evolution since 1910; Dezincing of Lead Concentrates at the Sullivan Concentrator; Design of the Flotation Section; Segregation Process; and Anionic vs. Cationic Flotation of Potash.

Flotation Mill Control; Instrumentation—the Overall Effects on Flotation Milling; Flotation Theory and Mill Control; Ore Microscopy in Flotation; X-Ray Analysis of Mill Products; Controlling Coal Flotation Circuits; and Technical Efficiency of Concentration Operation.

Preparation of Ores and Minerals for Flotation; Hydroclones at Cerro de Pasco Concentrating Operations; Preparation of Climax Molybdenite Ores for Flotation; Attritioning and Conditioning in Flotation of Spodumene Ore; The Leach-Precipitation Flotation Method of Concentration at Miami Copper Company; and Preparation of Nickel Ores and Synthetic Ores for Flotation.

Climax Molybdenum Company has driven and concrete lined its new **Ceresco** adit 1,153 feet at its Climax molybdenum mine. Both the portal section of the adit and a section from 853 to 1,153 feet were driven in fractured rock. The section from 1,125 to 1,153 feet required installation of steel sets on 2-foot centers. The adit was driven by **Boyles Brothers Drilling Company** of Salt Lake City, Utah under contract. Boyles has been awarded an additional contract to drive 3,700 feet of fringe drift and a ventilation lateral. Ceresco will be a new mine for Climax southeast of the main ore body and is scheduled to be in production in 1965 at the rate of 5,000 tons per day. Ed Eisenach is resident manager at Climax.

A new contract has been signed between the **United States Atomic Energy Commission** and the **Union Carbide Nuclear Company**, assuring continued uranium mining operations in the Uravan Mineral Belt of the Colorado Plateau and milling at Uravan and Rifle, Colorado. The basis for determining allocations in the Uravan Mineral Belt may be the historical production rate rather than developed ore reserves. Where the historical basis is used, the allocation will relate to ore production from July 1, 1956, through June 30, 1960. Sufficient mill capacity in the area will be available to treat eligible ores from qualified independent producers. Union Carbide may deliver 3,000,000 pounds of U_3O_8 annually of which no more than 2,500,000 pounds may be derived from company-controlled ores. This 2,500,000-pound annual limitation may be reduced to 2,200,000 pounds should additional independent ores be offered. In the event a further market in excess of 800,000 pounds annually is required for independent ores, total annual deliveries may be increased.

Eastern

Davison Chemical Division of **W. R. Grace & Company** is erecting a new Bucyrus-Erie dragline to be used at the **Bonny Lake** phosphate operations in Florida. The new machine is part of a current expansion program, and is capable of digging to a depth of 115 feet to lift 20 cubic yards of phosphatic material.

American Cyanamid Company has announced a multi-million dollar expansion of its Brewster, Florida, operations to produce an additional 200,000 tons per year of granular triple superphosphate. In addition, a new course triple superphosphate and an increased supply of run-of-pile material will be available, according to C. D. Siverd, Agricultural Division general manager.

International Minerals & Chemical Corporation has announced an extensive land reclamation program to expand facilities at International Park, near Bartow, Florida. The recreation area of the park will be enlarged with six additional golf course holes and a new swimming pool.

Tri-State Zinc, Inc. has a three-shift diamond drill working to complete pilot holes for possible shaft sites at its **New Market** zinc ore body in Eastern Tennessee. All holes are expected to go between 1,600 and 2,000 feet deep, and one hole has already been completed. **Joy Manufacturing Company** has the drilling contract.

The Feldspar Corporation flotation plant in Middletown, Connecticut, has now been in continuous operation since January of this year, and shipments to the glass and ceramic industry have increased substantially each month. C-20 glassmaking feldspar and C-6 pottery grade spar have been in such demand that the company has postponed production of high potash pottery grade material.

Formation of the **Phosphate Area Safety Council** by the nine phosphate companies operating in Florida's Polk-Hillborough county field was announced recently. President C. C. Hennessey, **American Cyanamid Company** safety director, said the council will "exert and organize effort toward preventing accidents and improving the health conditions of all persons connected with phosphate mining and allied operations in the Florida phosphate area, at work and at home."

Loral Electronics Corporation of New York is going into the beryllium business by acquiring the assets of **American Beryllium Corporation** and its two subsidiaries, **Visioneering Company** and **United States Beryllium Corporation**, for 95,840 shares of Loral Electronics stock. American Beryllium has two plants in Sarasota, Florida, and U. S. Beryllium has a plant in Inglewood, California. The three plants fabricate beryllium metal into various components for missile guidance and other equipment. Visioneering is the research and development subsidiary of U. S. Beryllium, and is not the exploration and mining company of the same name active at Badger Flats, Colorado.

Members of the Florida Section, AIME, were warned at a recent meeting that export sales of Florida phosphate are in jeopardy because of increasing competition from foreign sources. Speaker at the meeting was Dr. F. C. Kruger of Skokie, Illinois, director of mining and exploration for **International Minerals & Chemical Corporation**, who said that it is possible Russia could make a politico-trade issue out of phosphate and wage a price war. He also said that French colonies in North Africa might well decide to settle

St. Joseph Shuts Down Bonne Terre Mine and Mill

After nearly 100 years of continuous operation, all mining and milling at the Bonne Terre, Missouri properties of the St. Joseph Lead Company are being discontinued and the mines will be allowed to fill with water.

The present lead price, coupled with the low grade and limited amount of ore remaining in the Bonne Terre mines have made it economically impractical to continue to operate or keep the mines dewatered, according to an announcement made by E. A. Jones, division manager.

Shutdown has already begun with development drilling halted at the end of June, and operating drilling continuing only until late July. The last broken ore will be hoisted and milled during August, and final salvage of equipment and pumps will continue through October.

St. Joseph recently put into production a new and higher grade lead mine at Viburnum, Missouri, where a second mine will start production in September.

Sales and production have been nearly equal this year, according to Jones, and as a result the company's stockpile of metal has remained at from 65,000 to 67,000 tons. Hoped-for tariff or other government aid has not materialized, Jones said, and with no market for the metal the company cannot continue to operate the Bonne Terre mines.

their differences, and improve their methods and equipment to pose a threat. Foreign expansion includes new mines in several South African areas which could produce high-grade concentrate up to 3,000,000 tons annually, which is about the present amount of Florida's total exports.

Idaho

Promising showings of galena, chalcopyrite, and azurite have been uncovered by bulldozing at the property of **R-G Mining Company** in the Beaver Creek area of the Coeur d'Alene mining district, 14 miles north of Wallace. J. E. VanGundy, Spokane mining engineer, is directing work.

The **Galena** mine, in the Silver Belt of the Coeur d'Alene mining region, Shoshone County, is yielding about 420 tons of silver-copper ore daily. Cross cutting on the 3,200-foot level toward the projected downward extension of the North vein, first opened on the 3,000-foot level, has intersected a narrow but high grade silver-bearing structure with a different strike. A "Raise Climber" has been put into operation in the mine. J. C. Kieffer, Wallace, is manager of the Northwestern Mining Department for the lessee, **American Smelting & Refining Company.**

The **Bunker Hill Company** is planning to enlarge its phosphoric acid storage facilities to reduce shutdown periods of its phosphoric acid plant resulting from seasonal slacks in demand. A 2,000-ton tank is to be added to the present three 1,000-ton tanks. The firm's mining, smelting, metallurgical and acid plants are in the Coeur d'Alene mining region.

Shaft deepening at the **Conjecture** silver-lead mine in the Lakeview district, Bonner County, has been proceeding at a rate of about nine feet each 24 hours. At last report the shaft had been extended 800 feet below the 1,000-foot level en route to the 2,000-foot point. **Federal Resources Corporation,** Salt Lake City, Utah, is the operating company. Donald E. Majer, Spokane, heads **Conjecture Mines, Inc.**

Day Mines, Inc., Wallace, is doubling its efforts this year to find new mining properties. In recent years the firm has curtailed its base metal operations and currently receives nearly 60 percent of its income from gold and silver. Henry L. Day is president.

The **Crescent** mine, just west of the **Sunshine** mine is yielding 3,200 tons of silver-copper ore a month from between the 2,800 and 3,100-foot levels. The ore is trucked to the nearby **Polaris** mill of **Hecla Mining Company** which treats **Silver Summit** mine ore. The Crescent is owned and operated by **The Bunker Hill Company,** Kellogg, Charles E. Schwab, president.

At the Bayhorse District joint venture of **Sidney Mining Company** and **Umont Mining, Inc.,** exploration work is underway on both sides of the gulch. Drifting on the Beardsley fissure has yielded two cars of lead-zinc silver ore and crosscutting has been undertaken. Drifting on the K-7 fissure had opened a 50-foot length of ore at last report. M. C. Brown, Kellogg, is president of Sidney, the operating company.

Coeur d'Alene Mines Corporation has been doing some exploratory diamond drilling on the 1,400-foot level of its mine near Osburn, Shoshone County. It has not yet succeeded in reopening its 1,000-foot level to carry out diamond drilling of the Wire Silver vein in adjoining **American Silver Mining Company** ground. Harlow Rice, Wallace, has been elected president to succeed the late Dr. H. C. Mowery of Wallace.

Golconda Lead Mines has taken steps which might lead to further exploration of its holdings when lead-zinc prices improve. Golconda controls the **Square Deal** property and has substantial interests in the **United Lead-Zinc** and **Alice Silver-Lead** properties, all of which are adjacent to the Golconda mine east of Wallace, Shoshone County, Idaho. Wray Featherstone of Wallace is president.

Iron Ranges

Reopening of the **Corsica** mine, now being operated by **Lake Mining Company** in conjunction with the **Embarrass** mine, on the eastern Mesabi Range, is expected shortly as dewatering continues. The open pit was closed in 1954 due to lack of demand for ore, and became flooded to a depth of 264 feet with an estimated 1,500,000,000 gallons of water. Dewatering the pit started in March 1960, pumping at a rate of 5,400 gallons per minute which later reached a peak of 8,100 gallons per minute. Repair work is now being done on the washing plant, and wet screening facilities are being installed. When operating the plant will treat 2,500 tons of crude ore per shift.

The Hibbing Laboratory of **Pickands Mather & Co.** was expanded recently to provide space for continuous tonnage tests of an entire flowsheet, using small models of actual processing machinery. The laboratory, focal point for the firm's continuing experimental and research work on iron ore, was built in 1942 and several significant metallurgical developments have had their start there. Kenneth E. Merklin, chief metallurgist, heads a staff of over 20 employees at the facility.

Snyder Mining Company has transferred the Duluth offices of **Shenango Furnace Company** and Snyder Mining to the Shenango location at Chisholm, Minnesota. Duluth personnel transferred to the Mesabi Range are: Vernon O. Youngdahl, comptroller, and A. S. Spensieri, tax supervisor. Charles Rudstrom is general superintendent of Snyder Mining Company with headquarters at Chisholm. The Snyder Mining Company is owned by Shenango Furnace Company with general offices in Pittsburgh. Shenango operates two blast furnaces at Sharpsville, Pennsylvania, a fleet of Great Lakes bulk vessels, and some manufacturing plants in the East.

Construction is proceeding on schedule at the **Cleveland-Cliffs Iron Company's Republic** flotation mill at Republic, Michigan. When the expansion phase is completed, which is expected sometime during November or December of 1961, the plant will have an annual capacity of 1,600,000 tons of concentrate per year.

Contractor for concentrator expansion is the **M. W. Kellogg Company.** Construction is also proceeding on schedule for the new pellet plant at the Republic plant which will handle concentrate from the Republic mill. Contractor for the pellet plant is **Arthur G. McKee & Company** of Cleveland, Ohio.

Montana

The **Southwestern Montana Mining Association** at its annual dinner meeting at Dillon went on record as opposing the reclassification of the Bitterroot-Selway Primitive area on the Montana-Idaho border because it would eliminate prospecting and mining. Leonard Lively of the **Lively Mining Company** of Melrose was elected association president.

Slag from **Hanna Nickel Smelting Company's** electric furnaces at Riddle, Oregon is now being used to make abrasives for sand blasting. A new company, **Mining-Minerals Manufacturing Company,** crushes, sizes, packs, and ships the slag to steel mills, the United States Navy, and other users.

The **Nancy Lee** lead-silver-copper mine near Superior, Mineral County, has been leased to the **Bunker Hill Company,** Kellogg, Idaho, by **Nancy Lee Mines, Inc.,** Kellogg, subject to approval of stockholders. The 25-year lease, with a 25-year renewal option, provides for Bunker Hill to purchase the present lease, mining equpiment, and 120-ton flotation mill of **E. G. Smith,** Osburn, Idaho. Smith has been mining and milling 70 tons of ore daily from an ore body which he developed on the 790-foot level. Bunker Hill would pay Nancy Lee royalties of 5 percent on marginal and development material and up to 15 percent on "good grade" milling ore. The lease includes 51 unpatented mining claims, 10 patented claims, a 200-acre mill site and 160 acres of patented timber claims. Lester A. Harrison, Kellogg, is Nancy Lee vice president and legal counsel.

Mining claims adjoining the **Nancy Lee** mine, Mineral County, have been optioned by two Kellogg, Idaho, firms—**Lookout Mountain Mining & Milling Company,** and **Caledonia Silver-Lead Mining Company.**

At the **New Departure** silver mine near Bannack, Beaverhood County, a seven-man crew has been sinking an 8 by 8-foot shaft on an ore body opened by bulldozing and also drifting into the hillside on the vein. An initial shipment of 15 tons of crude ore was made recently to the **ASARCO** East Helena smelter. Smelter settlement sheet showed 150 ounces of silver per ton and values in zinc, lead, and gold.

Swansea Mines, Inc., headed by C. L. Hewitt, Helena, has received Office of Minerals Exploration approval of an $18,-260 lead-zinc exploration project at the **Carbonate** mine, Heddleston mining district, Lewis and Clark County.

Spokane National Mines, Inc. has made its first shipment of ore from the **New Departure** mine near Bannack to **ASARCO'S** East Helena smelter. This was high-grade silver, lead, copper ore which was found in an unknown vein. The Montana Power Company is constructing a 3,500-foot-long power line to the mine. A compressor, hoist, and pumps are being installed by the company. The lower grade ore is to be milled in the company's reconditioned mill located in Bannack.

Ruby Gold Inc. has a contract with **American Exploration and Mining Company** of San Francisco, California for exploration and development of some 2,000 acres of mining claims in the Little Rocky Mountain mining district near Zortman. Ruby Gold, recently incorporated in Montana, is a subsidiary of **Gold Reserve Mining Company** of Bozeman.

Reopening of the **Leonard** mine at Butte, Silver Bow County, Montana, is planned by the **Anaconda Company** for late this year or early 1962. The mine was shut down in 1958 and several months of work will be required to prepare the mine for new production. It will be reopened under a five-year, multi-million dollar project to mine high-grade ore at great depth. Production of 1,000 tons of copper ore daily is planned for the Leonard and an estimated 300 miners will be needed.

The **Calvert Creek** tungsten mine in Beaverhead County is operating at capacity since orders for tungsten concentrate are in excess of 60 percent of its total expected production through September according to R. G. Sullivan, president of **Minerals Engineering Company,** owner and operator of the open pit mine. A joint venture to produce vanadium with **Susquehanna-Western, Inc.** will begin operations at Garfield, Utah in October.

Nevada

A deep diamond drilling program with holes projected to depths exceeding 3,-000 feet is planned by the **Nevada Mines Division** of **Kennecott Copper Corporation** at its copper mines in the Ruth district of White Pine County. Kennecott is now mining and milling about 18,000 tons of ore a day from the Liberty pit. It has developed the **Minnesota High** ore body for block caving and has sunk a shaft and done some development work at the nearby, but not contiguous, **Deep Ruth** ore body. Deeper drilling in view of the geologic knowledge gained from developing these deep ore bodies is a logical step in finding unknown ore to perpetuate the operation. John C. Kinnear, Jr. is division manager.

Consolidated Eureka Mining Company is drifting on the 850- and 950-foot levels to explore the downward projection of ore mined above the 750-foot level at its mine east of Eureka. Ore mined near the surface was high grade lead-silver. Near the 750-foot level the lead content was lower and the ore was erratically distributed in small bodies which complicated and increased the cost of mining. Production in 1960 was 2,194 dry tons assaying 0.81 ounce gold, 9.1 ounces silver, and 7.0 percent lead per ton.

Field parties of the **United States Geological Survey** are actively geologic-mapping in Nevada this summer. One party is active in the Eureka district, another in northern Nye County, with a third near Battle Mountain. Topographical party surveys are being made of the

Kings River, Sonoma Range, Tobin Range, and East Humboldt Range of Humboldt and Pershing counties.

Manganese, Inc. has completed its contract to sell manganese nodules to the United States government and has closed its mine and plants in Clark County because there is no other market. The open pit **Three Kids** and adjoining mines have been closed as has the flotation mill and nodulizing plant at Henderson. High grade ore had been mined out several years ago and recent operations were centered on ore lower than 20 percent in manganese.

Eagle-Picher Company's diatomaceous earth plant at Colado, Pershing County, Nevada is operating at full capacity according to Ralph Yocum, manager. The company is developing two new open pit mines, No. 1 and No. 2, near Trinity Mountain. Depths to 150 feet have been excavated for large scale sampling.

Leprechaun Mining and Chemical, Inc. with headquarters in Las Vegas, Nevada is planning a pilot plant to extract potash salts from saline brine deposits in Clayton Valley west of Goldfield, Nevada. Twenty-eight holes have been drilled in the valley to sample the deposit. **Associated Chemicals Company of Pomona, California** has been negotiating with Leprechaun to determine recovery methods for the potash and other minerals.

The Anaconda Company is progressing on schedule in construction of a $6,000,000 flotation mill that will treat sulphide ore from its Weed Heights, Nevada open pit mine. The 5,000-ton-per-day mill will incorporate fine grinding and flotation equipment, filtering and drying facilities, and storage areas for coarse and fine ore. The plant is scheduled for completion late this year.

The **Nevada Porphyry Mining Company** has opened the hardrock gold mining areas near Round Mountain, Nevada, for lease. A few operators began work in February.

New Mexico

Sabre-Pinon Buys Partners Out of Homestake-New Mexico

The minority partners in the Homestake New Mexico Partners have sold their interest to Sabre-Pinon Mining Company, Sabre-Pinon is already Homestake's partner in Homestake-Sapin Mining Company. Both companies operate uranium mines and mills in New Mexico's Ambrosia Lake uranium district. Sabre-Pinon now controls 72.5 percent of Homestake-New Mexico Partners.

Sabre-Pinon purchased the minority interests for both cash and Sabre-Pinon shares. Hidden Splendor Mining Company, the successor to Rio Del Oro Uranium Mining Company which was one of the original partners, sold its interest for $3,150,00. Another minority group comprised of White Weld and Company—E. H. Whitney—San Jacinto Petroleum Company received $550,000 in cash. Still another partner—United Western Minerals Company received 228,440 Sabre-Pinon shares.

As now formed, the remaining minority partners are: Homestake Mining Com-

pany 24.25 percent, and Clyde E. Osborn 3.0 percent.

The Partners operate the Section 32 mine, the Rio del Oro mine which is virtually mined out, and the 850-ton-per-day carbonate leach mill with its large stockpiles of ore. The mill is a large processor of Ambrosia Lake custom ore mined by independent producers as well as Partners' own ore.

Mine sampling and assaying have been speeded at the **Chino Mines Division** of **Kennecott Copper Corporation** by use of a new Houston Tool Company vacuum drill and an X-ray spectograph. The new drill bores sample holes in the open pit and collects seven feet of sample per hour. After the chip and dust samples have been collected they are taken to the mine assay office where a special sample is prepared for the spectograph. All samples are run for copper; some for molybdenum, iron, lead, sulphur, and gold by the machine. The spectograph can identify and determine the amount of 24 separate elements in the ore. The operator sets a selector switch for minerals he wants assayed and the machine delivers a printed slip showing assay results within a few seconds. E. A. Slover is general manager of the division and Dale Ballmer is mine sample foreman.

A new ventilation shaft has been drilled to a depth of 640 feet at **Lance Corporation's Blackjack No. 1** uranium mine at Smith Lake, New Mexico. The 42-inch shaft was drilled and cased to 36 inches in less than two weeks using a special Hughes plate bit and an oil well type derrick. This large hole rotary drilling was pioneered by **Kermac Nuclear Corporation** at its Ambrosia Lake uranium mines 15 miles east of the Blackjack. About 15,000 tons of ore is mined each month by a crew of 90 men under the supervision of mine superintendent Bob Lovergn. Ore is trucked to **Homestake-Sapin Partners** uranium mill south of Ambrosia Lake for processing.

A germanium-copper-uranium exploration program near Santa Fe, New Mexico, has been described as "promising" by J. Patrick Lannan, president of **Susquehanna Corporation.** Susquehanna operates custom uranium mills in Wyoming and South Dakota and has just placed the first Texas uranium mill in operation south of Dallas.

The **Anaconda Company** has transferred a second five-year electric shovel from its **Jackpile** open pit mine for stripping at the new **Paguate** open pit mine on the Laguna Indian Reservation two miles northwest of the Jackpile. The new mine is scheduled to start ore production and stockpiling in March 1962. First ore will actually be milled in January 1963 after the Jackpile has been closed on schedule at the end of 1962. The Jackpile won't by any means be mined out, but under Anaconda's sales contract with the **Atomic Energy Commission** it will be cheaper to mine the Paguate. The Paguate ore body was discovered in June 1956 during an extensive diamond drill exploration program, but stripping started only in February of this year. A third electric shovel will be moved to the new mine in December after enough ore has been exposed at the Jackpile to assure production through 1962. John Herndon is Anaconda's pit superintendent.

Oregon

Gold interest picked up a little in Oregon this summer as two Baker County placers were tested; the **Pine Creek** placer north of Halfway by the **McDonald Brothers,** and the **O'Brien Creek** by **Bill Wood** and **Bill Close. J. E. Inman** and **J. E. Fitzpatrick** hydrauliced and washed about 150,000 cubic yards of gravel through their sluice boxes at the **Joe-Joe** placer (**Ruble**) mine on Upper Coyote Creek, Josephine County.

A $54,300 lead-zinc-copper exploration project at the **Musick** mine, Bohemia mining district, Lane County, is being undertaken by **Emerald Empire Mining Company** under a lease from **Lane Minerals Company.** The Office of Minerals Exploration will participate on a 50 percent basis in driving a 1,200-foot tunnel 335 feet below the No. 6 level. Wayne R. Giesy, Corvallis, is company president; Kenneth O. Watkins, Corvallis, vice president.

Rare Metals Corporation of America has leased the **Hulin** quicksilver claims in the Burnt River district, Baker County. Company geologists started preliminary exploration of the claims last spring. Rare Metals operates a 260-ton-per-day open pit mercury mine and furnacing plant near Weisser, Idaho.

Kermac Nuclear Fuels Corporation plans to operate the recently purchased **Lakeview Mining Company** as the **Lakeview Division** of the **Gunnison Mining Company.** J. L. Robison will continue as general manager with headquarters in

Gunnison, Colorado. Tentative plans have been made to modify and operate the Lakeview uranium mill to produce vanadium pentoxide six months of the year and uranium yellow cake the other six. Company metallurgists at Kermac's Golden, Colorado laboratory have been developing a vanadium extraction circuit for Lakeview. Kermac acquired Lakeview and Gunnison Mining companies by a stock exchange.

South Dakota

Estimated ore reserves at the **Homestake** gold mine of **Homestake Mining Company** in Lead South Dakota, on January 1, totaled 13,727,000 tons with an estimated value of $12.35 per ton, compared with reserves a year before of 13,872,000 tons at $12.40 per ton. Development at 300-foot intervals between the 5,000 and 6,200 levels has revealed ore comparable in grade and mineralogy to that throughout the mine, but in smaller and presumably less continuous ore bodies. The company completed most of the drilling on the Main Ledge and Nine Ledge ore bodies. Although results in the latter were disappointing, good ore was found in the Main Ledge, but the area of indicated ore on the 6,200 level was smaller than on the 5,900 level. The company believes there are at least 2,500,000 tons of average grade ore in this deep block. A $1,500,000 program to prepare the deeper levels for mining at a rate of 800 tons a day is now in progress, and the mill is being enlarged to handle the increased output.

Utah

Kennecott Copper Corporation and the International Union of Mine, Mill and Smelter Workers have signed a one year contract extending through June 30, 1962. The contract covers Kennecott's operations in Utah, Nevada, Arizona, and New Mexico. It calls for a seven cents per hour pay increase, an increase in increment between job classes and further elimination of the "southwest differential." Other fringe benefits are included.

New Park Mining Company's consulting metallurgist, Robert A. Porter, is designing a 300-ton-per-day flotation-cyanide mill to treat New Park mine ore. The mill will be designed to treat the high gold-silver and some copper ore from the Pearl vein and the zinc-lead-silver-copper replacement ore from the Mayflower stopes. It would treat Pearl ore two days a week, mined from the 18- to 24-inch wide vein above the 2,500 foot level where it has assayed as high as 8.0 ounces per ton. The Mayflower ore would be milled five days a week. The cyanide circuit of the mill will recover the gold as bullion. Flotation concentrates will be shipped to custom smelters.

Mill construction at the mine near Heber, is scheduled to start this fall with operation to begin by the first of 1962. W. H. H. Cranmer is company president.

The first beneficiation plant built in Utah to treat iron ore has been completed and placed in operation by the **Utah Construction and Mining Company** at Iron Springs, west of Cedar City. The plant has a capacity of 120 tons per hour and treats ore as low as 20 percent iron. Dry magnetic cobbing recovers plus-¼-inch, minus-2-inch concentrate with wet separation being used for the minus-¼-inch fraction. Bud Wilson, with headquarters in San Francisco, California, is Utah's mining vice president.

Stearns-Roger Manufacturing Company of Denver, Colorado has completed erection of the 168-foot-high headframe and hoist room at the new potash shaft of **Texas Gulf Sulphur Company** at Cane Creek. The bottom 123 feet is reinforced concrete on top of which a steel building has been erected to house the Koepe type hoists which will lift 10 ton skips at the rate of 2,800 feet per minute. Stearns-Roger is prime contractor and has sublet grading and excavation for the flotation mill to the **Isbell Construction Company** of Reno, Nevada. **Harrison International Company** is sinking the 2,800-foot-deep 22-foot-diameter circular shaft under contract. First potash is scheduled to be mined in late 1962.

Three new mining records were set at the **Utah Copper Division** of **Kennecott Copper Corporation** in April. The first was mining of 277,642 dry tons of ore (1,099 cars) and waste (2,497) to surpass the old record set in 1960 by 1,590 tons. The second was for record stripping of waste set in 1960 by 1,950 tons. The second was for record stripping of waste in one day—187,109 tons (2,552 cars). The third was set by John Gallegos when he drilled 1,002 feet of blast hole to beat the old record of 816. This record only lasted a short time as 1,050 feet were drilled, 35 30-foot deep holes, with

the No. 1 mobile drill on May 13th. R. F. Gough is general superintendent of mining and milling for the Division.

Shattuck Denn Mining Corporation expects to be operating its uranium properties in the Green River District in the post-1962 purchase program of the **Atomic Energy Commission**, according to Thomas Bardon, president. The company operates one mine of its own, and leases and operates a second property from Thomas Rowland of Denver. Total reserves are estimated at more than 75,000 tons.

The **United States Smelting Refining and Mining Company** is now operating a prospector's center at its Midvale, Utah, custom flotation mill at 29 North Holden Street. Free visual examination is made for gold, copper, lead, zinc, and silver minerals in hand samples brought in or mailed from Arizona, California, Colorado, Idaho, Montana, Nevada, and Utah. Blaine Watts is ore buyer at the center.

United Park City Mines Company is developing a high grade silver-lead-zinc ore zone in the Humburg formation in the **Daly West** and **Daly Judge** mines. More than 4,000,000 tons of ore have been mined from the shalower Jenney formation in the same area. United Park has been conducting a joint deep exploration program at its Park City mines for the last two years with the Office of Minerals Exploration. More than 2,000 feet of strike length along the fissure in the favorable bed will be explored. S. K. Droubay is vice president and general manager.

During 1960 employees of the **Utah Copper Division** of **Kennecott Copper Corporation** made 3,053 work improvement suggestions to management. Of these 425 were adopted and 37 percent of these resulted in tangible savings estimated at $42,125 for the year. Leaching tests continue at the **Bingham Canyon** mine's waste dump where a 168,000-ton experimental dump is being leached with varied acid concentrations. It was learned that by controlling leach water acidity the iron and aluminum salts build-up in pipe lines and ponds was eliminated. When acidity was controlled on the operating dumps it was found that rate of water circulation could be increased with a corresponding increase in amount of copper produced by leaching. J. P. O'Keefe is Utah division general manager.

Washington

Daybreak Uranium, Inc., recently shipped 248 tons of autunite ore from its **Dahl Lease** in the Mount Spokane district, northern Spokane County, to **Dawn Mining Company's** mill at Ford, Washington. The shipment averaged 0.177 percent uranium oxide.

Goldfield Consolidated Mines Company has taken up an option to buy 51 percent of the **Schumaker** lead-zinc mine, Northport mining district, Stevens County, from **Triton Mining Company.** The sum was undisclosed. The action followed a month's development of an ore body discovered by Triton in extending an old shallow tunnel. Development work was on an around-the-clock basis. Triton now shares in expenses on a 49 percent basis. Reopening of Goldfield Consolidated

Mining Company's **Sierra** zinc mill in the same district to concentrate the Schumaker ore was being considered at last report. Truman (Cy) Higginbotham, Colville, is general superintendent of area operations for Goldfield. Darrell Newland, Colville, heads Triton.

A gold-copper-silver prospect near Danville, northern Ferry County, is being developed by a newly organized Spokane firm, **Gold Bug Mining Company.** Forrest C. Renslow, Spokane, is president and superintendent.

Dawn Mining Company has optioned the **Gold Gulch** copper prospect three miles west of Nespelem, Colville Indian Reservation, from Joseph C. Ott, Kennett C. Scalf, and Ronald G. Hollinger, all Nespelem, and Verne S. Johnson, Spokane. Diamond drilling and stripping are planned by Dawn, owner and operator of the **Midnite** uranium mine in the Spokane Indian Reservation and of the adjacent Ford, Washington, uranium processing mill. J. A. Pike is manager of the **Newmont Mining Corporation** subsidiary.

Herbert Sams, Elk, Washington, drilling contractor, has resumed open-pit mining and drill exploration work on the **Dahl** lease, Mount Spokane uranium district, under a profit-sharing agreement with **Daybreak Uranium, Inc.**

An explosive charge is used to anchor a new-type rock bolt developed in the **U. S. Bureau of Mines'** Spokane Office of Mining Research. In recent anchorage tests at the **Star** zinc mine near Wallace, Idaho, Primacord was used as the explosive to expand the bolt's hollow tubing head. Earnest R. Rodriguez is chief of the office.

The **Anderson mine** near Leadpoint, northern Stevens County, has been shut down pending improvement in zinc-lead prices and plans for construction of a 1,000-ton mill are being held in abeyance by **Goldfield Consolidated Mines Company.** The second phase of a large-scale development program has been completed, however. This, which followed a successful diamond drilling phase, included driving of a 13 by 15-foot access haulageway for 950 feet on a 10 percent downgrade from the bottom of the Anderson open-pit mine. A 500-foot drift and a raise to near the surface also were completed. All the footage was in ore and 20,000 tons were stockpiled. T. (Cy) Higginbotham Colville, is resident manager for Goldfield.

Development of the new 11th level at the **Gold Dollar** mine Republic Camp, Ferry County, Washington, has added several years of ore to reserves; downhole diamond drilling has indicated that the vein persists to the 13th level. Production in 1960 totaled 41,376 tons of gold-silver ore of "excellent" grade. The Gold Dollar, owned by **Day Mines, Inc.,** Wallace, Idaho, is being worked by **Knob Hill Mines, Inc.,** from its adjoining shaft workings. Adjoining properties owned by the two firms were jointly developed on an expanded scale last year, with 5,638 feet of drifting and crosscutting, and 12,188 feet of diamond drilling. An unknown ore body, No. 3-JO discovered on the 8th level northwesterly, has been developed for more than 400 feet in length and ore is of "fair" grade across drift width. Henry L. Day, Wallace, is president of Day Mines.

Extension of the old Gubser tunnel in the Conconully district, Okanogan County, Washington, is the object of negotiations which **Sunny Peak Mining Company** is carrying on with an active Okanogan operator. Sunny Peak made repairs to track and air pipe in 1960 and assembled equipment in preparation for doing additional work in the Gubser silver-copper-lead property. E. I. Fisher, of Spokane, is secretary of Sunny Peak.

Rare Metals Corporation of America has taken an option to lease and purchase the old **Red Top** lead-zinc-silver mine, Northport mining district, Stevens County. It plans about $15,000 worth of exploration work this year. Work would include driving a tunnel to get added depth on an ore shoot in which the late A. C. Neiman was sinking when killed in a premature dynamite explosion in 1958. R. H. Mills, Spokane, is manager of the Red Top firm.

Wyoming

Closed circuit television has been installed in the crushing and sampling plant of the **Riverton** uranium mill of **Susquehanna-Western, Inc.** Three monitoring cameras have been installed, one at the primary apron feeder, at the feed chute to the primary crusher, and the feed chute to the small crusher ahead of the final sampler. Each camera has its own viewing screen in the central control room to permit the operator to check ore flow and stop any piece of equipment should the feeders or belts bridge with ore. A duplicate installation is being made at the firm's uranium mill at Edgemont, South Dakota.

The No. 1 circular manshaft has been completed at **Stauffer Chemical Company's** new trona mine northwest of Green River. The circular production shaft with separate hoisting and ventilation compartments is scheduled for completion in mid-September. **Winston Brothers** is contractor for the shafts and the new mill which will convert trona into soda ash.

Union Pacific Railroad Company has hired the **Koppers Company** to make an economic and feasibility survey for a proposed steel mill north of Laramie, Wyoming. Ore for the mill would be mined from the railroad's **Iron Mountain** titaniferrous magnetite deposit. Coal would be mined in the area. Iron Mountain has long been known to have large reserves, but the titanium content has precluded its use as ore in blast furnaces. The railroad has made a large scale furnace test at Pioche, Nevada to determine if the Krupp Wrenn process was economical for using on the ore. Koppers will now evaluate the Strategic-Udy process for utilizing the ore.

The new 76-mile-long broad gauge railroad has been completed from Winton Junction to the new taconite mill of **United States Steel Corporation** at Atlantic City, Wyoming. The new mill is scheduled for operation in late 1962 to beneficiate ore mined from the leased claims of the **Ruby Company** of Boise, Idaho. Mill erection, and construction of water and tailing dams is on schedule.

Grandview's Equipment Incline Completed

Mine officials John W. Currie (left) and O. M. Hagberg motor out of Grandview zinc-lead mine in Washington's Metaline district. The mine is owned and operated by American Zinc, Lead and Smelting Company, whose mechanization of the mine includes closed circuit TV.

New at the mine is the "truck portal" which enables Diesel-operated trucks and mining equipment to be driven directly into the mine instead of being taken down the shaft in pieces and reassembled underground. Fifteen feet square, it was blasted out of hard limestone for a distance of 500 feet from the mine's 100-foot level. From it, a two-mile surface road was constructed to the mine surface plant. Mine Superintendent Hagberg now drives an Austin Gypsy, a British-made, jeep-like Diesel truck, through the mine, saving about 10 miles of walking each day. A truck with a Diesel tractor engine is used to haul explosives and other supplies into the mine.

Underground roadways total about 10 miles and wind down to an elevation of 1,700 feet from 2,530 feet above sea level. They extend 2¾ miles northeast of the surface plant and mill and connect with the adjoining Pend Oreille mine of Pend Oreille Mines & Metals Company at the 300-foot level. Mining is done by tractor-propelled drilling jumbos and Transloaders, self-loading, rubber-tired Diesel trucks developed by American Zinc. Production is 950 tons of zinc-lead ore daily. Mr. Currie, is resident manager for American Zinc.

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5′ x 5′, 6′ x 4′ & 6′ x 9′ Traylor Ball Mills
No. 56 and 7′x15′ Marcy Ball Mills
10′ x 48″ & 5′ x 22″ Hardinge Ball Mills
4′x11′ & 7′x15′ Marcy Rod Mills
636 Allis Chalmers Hydracone
20″ Allis Chalmers Gyratory Crusher
12″ x 26″, 14″ x 28″, 18″ x 36″, 30″ x 36″, 48″ x 60″, 66″ x 84″ Jaw Crushers
8″ x 10″ Denver Jaw Crushers, rebuilt
24″x14″ & 42″x16″ Type B A.C. Roll Crushers
5½′ Symons Std. Cone Crusher
7′ Symons Snort Head Cone Crusher
78″x36′6″ Akins Duplex Spiral Classifier
8′x37′x19′ Dorr Bow Rake Classifier
6′x50′ & 8′x60′ Rotary Dryers
7′ x 120′ & 9′ x 162′ Rotary Kilns
4–30″x32″ Dings Magnetic-Head Pulleys
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8, 12, 23, 25, 45, 100 & 115 ton GE & Alcoa Diesel Electric Locomotives
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Buckets, Slusher
1—48" Rogers, Slusher, Cast Steel
8—48" Vulcan Denver, Cast Steel
2—42" Vulcan Denver, Cast Steel

Blowers
6—I. R. Type 16G1415, "Motorblower", 15 HP
10—Buffalo, Size 6-E, 20 HP
1—Coppus, Vano, 30 HP
1—GE Turbo Compressor, 85 HP, 6500 cfm

Capacitor
1—600 KVAR, Outdoor, 2400v

Classifiers
2—Krebs, D48B
1—Krebs, D20
4—Dorrco, 8"
1—60" x 26' Wemco Spiral, 5 HP
1—72" x 32' Wemco Spiral, 10 HP

Compressors
1—XRB Ingersoll Rand, 100 HP
1—WJ-3 Sullivan, 150 HP
1—WN-4 Sullivan, 400 HP

Conveyors, Belt Type
1—25" x 100', 20 HP, 440v, Complete
1—18" x 100', 20 HP Motor, 440v, Complete
1—18" x 90', 7½ HP Motor, Complete
1—18" x 44', Steel Frame, 5 HP
1—24" x 70', Pioneer Stacking

Crusher
1—13-B Telsmith Gyratory, 75 HP

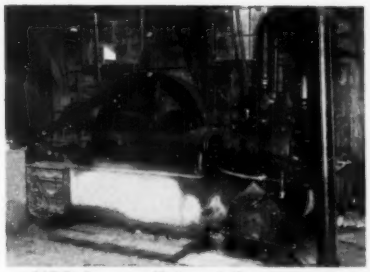
Drills
5—H-10 Cleveland, w/6' Airlegs
2—K-89 Jay Paving Breakers
2—J-10 IR Jackhammers

Dragline
1—¾ yd. P.&H., Model 255-A, w/Boom & Bucket

Fans
3—48" dia., Underground Type, 15 HP
1—Joy Axivane, 30 HP

Feeders
1—36" x 16' Marco Belt Type, 5 HP
1—24" Denver Cone Reagent, Complete
1—18" Denver Cone Reagent, Complete

Filters
1—6' - 3 Disc. Eimco, w/Filtrate Pump
1—6' - 4 Disc. Eimco, w/Filtrate Pump



XRB Ingersoll-Rand Compressor

Flotation Machines
2—6 Cell #5 Denver Equipt. Co., Sub. A
4—3 Cell #21 Denver Equipment Co.
1—6 Cell #21 Denver Equipment Co.
3—2 Cell 56" Wemco, 15 HP
2—4 Cell 56" Wemco
1—5 Cell 56" Wemco, 10 HP
1—1 Cell 56" Wemco, 10 HP
1—2 Cell 56" Fagergren, 20 HP
4—4 Cell 56" Fagergren, 15 HP
1—Unit Cell, 56" Wemco, 10 HP

Hoists, Tugger and Slusher
4—D6U Ingersoll Rand, Air Tugger
4—EU Ingersoll Rand, Air Tugger
2—HU Ingersoll Rand, Air
6—30 NNN 3D Ing. Rand, 3 Drum, 440v
4—30 MNM 3D Ing. Rand, 3 Drum, 440v
1—20 MNM 3C Ing. Rand, 3 Drum, 440v

Hoists, Mine Shaft
1—150 HP Rogers, 1 Drum, 440v
1—250 HP Allis-Chalmers, 1 Drum, 8' dia. Drum, Post Brake; 2200v

Loader
1—Eimco 630

Magnets
1—Dings Bi-Polar, Type BB
1—Dings Drums Separator, 36" x 42" Drum Type

Mills, Ball
1—16" x 16" Denver, Less Motor
1—30" x 36" Denver, Less Motor
1—#64½ Marcy, 100 HP
1—#86 Marcy, 250 HP
1—10' x 48" Hardinge, 400 HP

Mixers
3—"Lightnin", Type S-1, 1/3 HP
1—"Lightnin", Type D-2, ½ HP
1—Patterson Typhoon, ¼ HP

Pulverizer
1—UA Braun, Motorized, 2 HP

Pumps, Sand
2—1" Denver Vertical, ¾ HP
5—2" Denver Vertical, 10 HP
17—2" Wemco, Rubber & Iron Lined, 5 HP
5—3" Wemco, Iron Lined, 10 HP
8—4" Wemco, Iron Lined, 20 HP
2—6" Wemco, Iron Lined, 50 HP
1—8" Wemco, Iron Lined, 100 HP
1—6" x 8" Allis Chalmers, 100 HP
1—5" Denver Duplex Diaphragm

Pumps, Suction Pressure
3—¾" Denver Equipment Co., ½ HP

Pumps, Centrifugal
1—2 MRV-40 Ing. Rand, 440v
3—Size 25W, LaBour, 15 HP
1—4" x 3" American-Marsh, 4 Stage, 60 HP
1—5H Byron Jackson, 75 HP
1—4" Amsco Nagel, 7½ HP

Pump, Vacuum
1—22" x 9" Ing. Rand, ES-1, 40 HP

Samplers
1—16" Galigher, Automatic
6—21" Denver, Automatic

Screens
2—3' x 6' Allis Chalmers "Aerovibe", 3 HP
1—4' x 8' Symons Rod Deck, 7½ HP
1—4' x 10' Tyler Ty-Rock
1—5' x 12' Allis Chalmers, Lowhead

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Scale
1—100 Ton Howe Railroad Track

Thickener
1—14' x 6' Dagley, Steel Tank

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4—DW-10 Caterpillar, Ore Hauler
3—HD-9G Allis Chalmers, w/Loader
2—T-200 Allis Chalmers, Ore Hauler

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2—Merrick Model "E", 30-36" Belt

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2—Davenport 8' x 60' dryers, 7/16" welded
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3—Stearns-Roger 8' x 40' dryers, ½"
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1—7' x 6' x 100' rotary kiln, ½" shell
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1—Standard 6' x 60' dryer, 3/8" welded
2—4'-9" x 32' rotary dryers, 3/8" shell

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1—Hardinge 6' x 36" conical ball, 75 HP w/ fan, classifiers, etc.
1—Hardinge 8' x 48" conical pebble mill
2—Hardinge 7' x 36" conical pebble mills
1—Raymond 66", 6-roller hi-side mill
1—Farrel 36" x 15" jaw crusher
1—Buchanan 24" x 13" jaw crusher, 50 HP.
1—Allis-Chalmers 5' x 5' ball mill, 75 HP.
3—Allis-Chalmers 5' x 22' ball-tube mills
1—Allis-Chalmers 6' x 16' ball-tube mill

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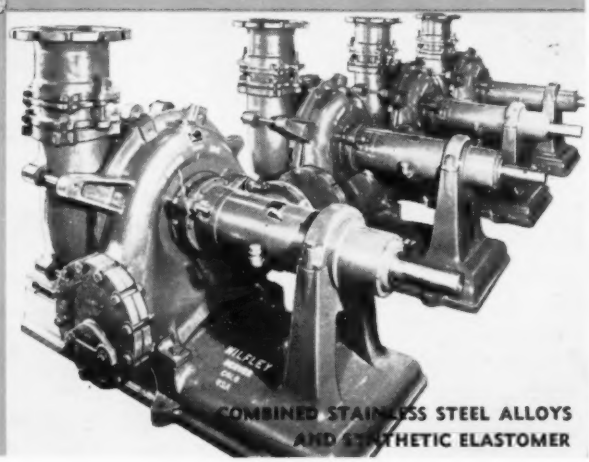

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